CASHEW NUT SHELL LIQUID

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SECTION I

PRODUCT CHARACTERISTICS AND SPECIFICATION

1.1 General details

Cashewnut Shell Liquid (CNSL) is a reddish brown viscous liquid, having the honey comb structure of the shell of cashewnut obtained from cashew tree.

Specifications

1.2.1 Natural CNSL

Anacardic acid  80.9%
Cardol  10-15%

Small amounts of other materials notably the methyl derivatives of cardiol

1.2.2 CNSL extracted with low boiling petroleum

Anacardic acid  90%
Cardol  10%
SECTION-II
APPLICATION OF CNSL RESIN

2.1. General Details

Cashewnut Shell oil is extracted from the honey-combed shell of the cashew nut and then sold in its raw or distilled form into two different markets: auto brake linings and industrial and marine coatings. In the coatings arena, cashew nut shell oil is used as a key raw material in the production of curing agents for special epoxy hardeners and epoxy resins.

<table>
<thead>
<tr>
<th>Coating sector</th>
<th>Industrial and marine coatings.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Paint (anti corrosive) and enamels, varnishes rubber industry to enhance the vulcanisate properties.</td>
</tr>
<tr>
<td></td>
<td>Lacquers developed from cnsl could be used for insulation, protective or decorative coatings for furniture, buildings, automobiles, etc.</td>
</tr>
<tr>
<td></td>
<td>In the coating arena, cashewnut shell oil is used as a key raw material in the production of curing agents for special epoxy hardeners and epoxy resins.</td>
</tr>
<tr>
<td>Construction sector</td>
<td>For cementing floors exposed to chemical attack.</td>
</tr>
<tr>
<td>Laminating industry</td>
<td>For reducing brittleness and improving the flexibility of the laminates.</td>
</tr>
<tr>
<td>Substitute</td>
<td>As a substitute for linseed oil in the manufacture of foundry core oil, which is used as a binder in the foundry.</td>
</tr>
<tr>
<td>Automobile</td>
<td>Auto brake lining</td>
</tr>
</tbody>
</table>


New applications:

Using cashenut shell liquid, a novel and cheaper liquid crystalline polyester has been synthesised that can substitute for polymer fibres and films in speciality applications.

Liquid crystalline (lc) polymers have attracted much attention in recent years because of their potential use as high performance materials.

2.2. Paints and Enamels

Because of its dark colour, CNSL is used in the manufacture of dark coloured paints and enamels.

A number of anticorrosive paint formulations for ship bottoms have been made by the Regional Research Laboratory, Hyderabad, the Central Institute of Fisheries Technology, Cochin, Bombay University and the Research, Design and Standards Organisation, Lucknow.

Paints and varnishes made from CNSL have superior properties than those of conventional oils or synthetic resins. Varnishes resistant to water and gasoline have been made by incorporating sulphur in CNSL.

Lacquers developed from CSNL could be used for insulation, protective or decorative coatings for furniture, buildings, automobiles, etc. The films have toughness and elsticity, excellent gloss and superfine adhesive qualities. The dried films are superior to those of ordinary oil paints in respect of resistance to oils, grease moisture and chemicals. Cashew lacquers are cheaper than ordinary oil varnishes.

2.3. Electrical Insulating Varnishes

Electrical Insulating varnishes are obtained by treating CNSL with formaldehyde and compounding the resulting material with pure phenolic resin varnish or alkyd resin in suitable proportions. Films of those materials are water and chemical resistant and can be used as insulating varnished with high electrical resistance and as bobbin enamels and laboratory table tops.

2.4. Polymers

Cashew polymers react with formaldehyde to give a rubbery gel, which can be used as a cement hardening agent that would be immune to acids and alkalies reaction. It can be used for cementing floors exposed to chemical attack.

CSNL modified by heating at 160 deg.C. in the presence of certain accelerators give stoving enamels that are resistant to alkali and acid solutions, mineral and fatty oils and
various organic solvents. Coating compositions possessing insecticidal properties are obtained by adding DDT, Gammexane etc., to CSNL or chlorinated CNSL after treatment with Formaldehyde gums and resins and drying or semi-drying oils.

Apart from the polymeric products, CNSL forms the basic raw material for a vast number of industrially important chemicals and chemical intermediates. Chlorinated products of cardanol and hydrogenated cardanol are found to have pesticidal action. The various components of cardanol can be suitably modified to obtain emulsifiers and surface active agents, dyestuffs, antioxidants, plasticizers, stabilizers, accelerators, curatives, reclaiming agents and ion-exchange resins.

2.5. Lamination

CSNL or Cardanol derivatives are extensively used in the laminating industry for reducing brittleness and improving the flexibility of the laminates.

A CSNL based adhesive for blending concrete to wooden surface has been developed by the Central Building Research Institute, Roorkee. Adhesives suitable for plywood are made by oxidising CSNL with potassium permanganate or Manganese dioxide at 100 deg. C reacted with Paraformaldehyde and compounded with Cuprous chloride. Also CSNL modified with furfural, aniline, xylol etc. gives good plywood adhesives.

2.6. Rubber Products

The use of CNSL in rubber compositions has been found to improve the performance of rubber products. It helps processing and enhances the vulcanizate properties. CNSL enhances the insolubility of natural rubber vulcanizates in petroleum solvents. It helps in the incorporation of ingredients into rubber and increases its resistance to moisture. Oxides of Cu, Ba, Zn, etc. harden CNSL and give hard products.

2.7. Phenoplasts

Cardanol and its derivatives can also be converted to phenoplasts with better processability, hydrocarbon solubility and resistance to acids and alkalies than the conventional phenol-based systems. Moulding powders from CNSL, shellac, and fillers such as wood flour, sawdust, asbestos, etc. are found to give articles with excellent finish, good flexural and tensile strengths and satisfactory water resistance.

Stable rigid or flexible covering materials in the form of tiles sheets, etc., are made from compositions containing CNSL, formalin, natural rubber and synthetic rubber and other conventional ingredients.

Light weight, sandwich type plastics, composite pannels suitable for partitions, claddings, flush doors etc. Have been developed using resins based on CNSL. Foam plastics based on CNSL and its derivatives have also been made.
The use of CNSL in rubber compositions has been found to improve the performance of rubber products. It helps processing and enhances the vulcanizate properties.

CNSL enhances the insolubility of natural rubber vulcanisates in petroleum solvents. It helps in the incorporation of moisture. Oxides of Cu, Ba, Zn, etc. Harden CNSL and give hard products.

CNSL also finds use in making floor tile laminate resins, oil-cloth finish compositions and as a rubefacient and vescicant in treating skin diseases and in tropical medicine. CNSL, is a unique monomer source for unsaturated phenols which can be polymerized to get various polymeric products can be suitably modified to chemical intermediates for industrial uses.

2.8. Modified CNSL

The various components of cardanol can be suitably modified to obtain emulsifiers and surface active agents, dyestuffs, antioxidants, plasticizers, stabilizers, accelerators, curatives, reclaiming agents and ion-exchange resins.

CNSL modified by heating at 160-300 degC in the presence of certain accelerators give stoving enamels resistant to alkali and acid solutions, mineral and fatty oils and various organic solvents.

Coating compositions possessing insecticidal properties are obtained by adding DDT, gammexane, etc. to CNSL or chlorinated CNSL, after treatment with formaldehyde, gums and resins and drying or semi-drying oils.

2.9. Derivatives of CNSL

CNSL or Cardanol derivatives are extensively used in the laminating industry for reducing brittleness and improving the flexibility of the laminates.

2.9.1. Adhesive

A CNSL-based adhesive for blending concrete to wooden surface was developed by the Central Building Research Institute, Roorkee. Adhesives suitable for plywood are made by oxidising CNSL with potassium permanganate or manganese dioxide at 100degC reacted with paraformaldehyde and compounded with CuCl₂. Also CNSL modified with furfural, aniline, xylol, etc. gives good plywood adhesives.

2.9.2. Binder in the foundry

CNSL is also used as a substitute for linseed oil in the manufacture of foundry core oil, which is used as a binder in the foundry.
2.10. Basic raw material

Apart from the polymeric products, CNSL forms the basic raw material for a vast number of industrially important chemicals and chemical intermediates.

2.11 Pesticidal action

Chlorinated products of cardanol and hydrogenated cardanol are found to have pesticidal action.

2.12. New polyester from cashewnut shell liquid

Using cashewnut shell liquid, a group of scientists have synthesised a novel and cheaper liquid crystalline polyester that can substitute for polymer fibres and films in specialty applications.

The team includes a scientist (RRL), Trivandrum, who is on a fellowship at the University of Strathclyde, Glasgow, United Kingdom, and D.C.Sherrington and A. Sneddon from Strathclyde. Their work was reported in the journal Polymer.

Liquid crystalline (LC) polymers have attracted much attention in recent years because of their potential use as high-performance materials. Earlier attempts to prepare the mototropic LC polymers have met with varied success as they yielded products that were insoluble and could not be easily processed.

Since then, scientists have been attempting to lower the melting point of these polyesters by various chemical methods to make them easy to process. The Glasgow team developed a new method using a natural material cardanol obtained from cashewnut shell liquid (from the plant Anacardium polymer poly (1,4-benzoate-1,3-phenyl octanoate).

Cardanol is similar to phenol except that it has an additional 15-carbon unsaturated sidechain. Like phenol, cardanol can be polymerised with formaldehyde. It can undergo a variety of polymerisation reactions and chemical modifications because of the additional side-chain Earlier studies by Pillai have shown that high-performance and speciality polymers could be produced from cardanol.

The significance of the new copolyester obtained by Pillai and his Strathclyde colleagues is that its transition temperature-256degC-is lower than that of two commercially available LC co-polyesters in the United States. These two polyesters-known in the market as Vectra and Xyder-have melting points near 300degC and are, therefore, difficult to process. The cost that of other similar products.
2.13. **Medicinal applications**

Cashew, the king of dry fruits, is not merely the best topping for a delicious last course, it is also an aphrodisiac that can boast of many curative properties. The latent and benign medicinal properties of cashew, of which India is the largest producer worldwide, are enormous, according to research data published by the Cashew Export Promotion Council of India, at Kochi.

Laden with 21% protein and an equally high percentage of poly unsaturated fatty acids, cashew helps in reducing the blood cholesterol level considerably preventing possibilities of heart attacks. With an exceedingly low content of saturated fat and soluble sugar, cashew could slim down one's waistline. Besides, cashew kernels, rich in calcium, phosphorous and iron, can help prevent anagemia and nervous system ailments, the research found. In fact, the vegetable proteins contained in cashew kernels stand at par with milk, eggs and meat. Besides, it also contains a high concentration of much needed acids in right proportions, generally very rare in nuts.

A cashew kernel contains 47% fat, 82% of this fat is unsaturated fatty acids. This unsaturated fatty acids helps in lowering blood's cholesterol level. The most prominent vitamins in cashew are vitamin A, D and E. These vitamins help in assimilating the fats and increase the immunity level. Being a rich source of minerals like calcium, phosphorus and iron, consumption of cashew kernels can help protect the nervous system as well.

According to the Indian Cashew Journal, an official publication of the Cashew Export Promotion Council, cashew kernel is very low on carbohydrates-as low as one per cent of soluble sugar-which means that one is privileged to a sweet taste without worrying about excess calories. One big property of cashew is that it helps in controlling diabetes, says the journal.

The recently discovered vitamin-PP also develops when a cashew is roasted, the journal says, adding that these vitamins exert a sparing action on the B group vitamins and assist in metabolism of lactose and thiamine. The presence of vitamin E in cashew takes care of all reproductive problems and prevents the development of oxidative rancidity in fats.

According to experts, at the council, high content of linoleic acid in cashew kernel makes it an ideal digestive assimilative stimuli since linoleic acid has a structure best suited to the synthesis of prostaglandins, the wonder substance found in many body organs and having a profound influence on various body functions. The process roasting and toasting kernels assists in increasing these properties.
Cashew kernel oil is also considered a good mechanical and chemical antidote for irritant poisons, and it is a vehicle for linaments and other external applications, experts point out. The kernel is also used as a substitute for almond mixture, and is a good food for patients suffering from incessant and chronic vomiting.

One of the most popular systems of Indian medicine, ayurveda also lists quite a few unique curative properties of Indian cashewnut and prescribes it as a good stimulant, rejuvenator, appetiser, excellent hair tonic aphrodisiac and restorative. Experts say raw cashew fruit was used as an anaesthetic in leprosy, and also for curing warts, corns and ulcers.

The juice of the nut is used as a substitute for iodine while the oil obtained from the shell is good for cracks in feet. The cashew apple contains 10.44 per cent of fermentable sugars and 261.5 mg per 100gm of vitamins C, giving both the fruit and the wine made of it very good antiscorbutic properties. The liquor is also valued as a diuretic with healthy effect on kidneys and advanced cases of cholera.

Apart from its commercial importance as an intoxicant liquor, cashew feni, very popular in Goa, is said to have high medicinal value and has for centuries been used by the Goans as a cure for ailments ranging from worm sickness in children to diarrhoea and even cholera.
SECTION III

IMPORT/EXPORT DETAILS

3.1. Imports: Negligible quantity

3.2. Exports

3.2.1. Present exports level of CNSL 1705 tonnes per annum

3.2.1.1. Annual exports of CNSL

![Bar Chart showing CNSL exports from April 1999 to March 2002]
3.2.1.2. Countrywise Exports of CNSL

**Period April 2001 to March 2002**

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity in Kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>817</td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>200</td>
</tr>
<tr>
<td>Japan</td>
<td>109000</td>
</tr>
<tr>
<td>Korea DP RP</td>
<td>44500</td>
</tr>
<tr>
<td>Korea RP</td>
<td>773600</td>
</tr>
<tr>
<td>New Zealand</td>
<td>28</td>
</tr>
<tr>
<td>Norway</td>
<td>5000</td>
</tr>
<tr>
<td>Slovenia</td>
<td>16000</td>
</tr>
<tr>
<td>Spain</td>
<td>1000</td>
</tr>
<tr>
<td>U Arab Emits</td>
<td>1000</td>
</tr>
<tr>
<td>USA</td>
<td>737420</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>16000</td>
</tr>
</tbody>
</table>

3.2.2. Cashew Shell Liquid (Cardanol) Purified & Distilled

3.2.2.1. Annual exports
3.2.2.2. Countrywise Exports Details

Period April 2001 to March 2002

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity in Kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>578</td>
</tr>
<tr>
<td>Belgium</td>
<td>20000</td>
</tr>
<tr>
<td>France</td>
<td>5</td>
</tr>
<tr>
<td>Japan</td>
<td>6000</td>
</tr>
<tr>
<td>Korea Rp</td>
<td>104600</td>
</tr>
<tr>
<td>U Arab Emts</td>
<td>3000</td>
</tr>
<tr>
<td>UK</td>
<td>91700</td>
</tr>
<tr>
<td>USA</td>
<td>62000</td>
</tr>
</tbody>
</table>
SECTION IV
INDIAN MANUFACTURERS

There are number of units in small scale sector. The Indian manufacturers of CNSL resin include the following.

* **Anant Chemical Industries,**
  Factory: B-55, MIDC Paithan, Aurangabad-431 148
  Phone : 32161 (02431)
  Office : 2 "Chinmay" Apartment
  Jyotinagar, Aurangabad-431 005

* **Anbu Cashew Chem (P) Ltd.**,  
  2/11, Main Road,  
  Kadampuliur-607 103.

  B-1/1, Sipcot Industrial Complex  
  Kudikadu,  
  Cuddalore 607 005

* **Benzochem Industries**  
  **Shed No.21, M.I.D.C. (Chemical Zone),**  
  Ambernath 421 501, Dist. Thane

  101, Motivilla, 140-C, Azad Road,
Vileparle (E), Mumbai-400 057

* **Cashew Oils & Resins P.Ltd.**,  
11/1, Postal Colony, Third St.,  
West Mambalam, Chennai 600 033.

Factory: 41, Kilakuppam Road, Kadampuliyr-607 103  
Cuddalore Dist.

* **Cashitron Industries**,  
At & Post: Gundbala-581 344.  
Tal-Ankola, Uttar Karnataka.

* **Cee Sulfones Ltd.**,  
B-7, Rajratan Apartments  
Ground Floor, Near Garden Service Road, Jogeshwari (E),  
Bombay-400 060

Factory: Plot No.146-149, Achhad Industrial Estate  
Taluka Talasari, Dist-Thane, Maharashtra

* **Cashitron Resins Pvt. Ltd.**,  
At & PO: Gundbala - 581 344,

Mumbai Office: S.M. Baleri Associates,  
6, Suyog, Gokhale Road (N),  
Dadar (W), Mumbai-400 028.

* **Jyothi Enterprises**  
9-4-3, Regimental Bazar,  
2nd Floor, Secunderabad-500 025.

Factory  
Shed No.43, Phase II, I.D.A.,  
Mallarpur, R.R. Dist.

* **Mothers Pure Herbs**  
46/1, Jaraganahalli,  
Kanakapura Road,  
Bangalore - 560078

* **Nayakem Organics Pvt. Ltd.**,  
Regd. Office: 221, Madhani Estate,  
542, Senapati Bapat Marg,  
Dadar (W), Mumbai - 400 028.
* **Pearl Synthetics and Chemicals**,  
11, Anupam Hsg. Society,  
Shreynagar, Osmanpura,Aurangabad-431 005  
Factory : PlotNo.B-28  
UdyogmitraCo-op. Indl. Estate,  
Gut No.26 (Part) Chitegaon  
Tal. Paithan, Dist. Aurangabad

* **Rishabh Resins & Chemicals**,  
15-E & F Sri Venkateswara Co-op  
Indl. Estate, Jeedimetla, Hyderabad - 500 055.

* **Rasaayan Udyog**  
Factory: Plot No.196, 213, Sy.No.170  
Part Doolapally Village  
Via Hakimpet, Secunderabad 500 014.  
Office: 5-9-22/41-B, Adarsh Nagar,  
Hyderabad 500 463

* **Sudarsan Phenomers**  
PIPDIC Industrial Estate,  
Kirumampakkam, Pondicherry-607 402

* **Sri Panduranga Industries**  
Hebri-576 112,  
Phone : 71178/71221 (STD) 08258.  
Factory : Shivapura (D.K.)

* **Sabarigiri Industries**  
Post Box No.10,27,Kumbakonam Road,  
Panruti-607 106.

* **Sathyashree Industries**  
Kanyana, Hebri 576 112

* **Selva Enterprises**,  
Post Box No.1.  
Kayamkulam, Kerala-690 502.

* **Swadeshi Resins & Chemicals**,  
West Hill, Calicut-673 005,Kerala.

**Indian installed capacity**  
20000 tonnes per annum
SECTION V

PRICE

Present price level for CNSL : Rs.16,000 per tonne
Taxes and duties : Extra as applicable
SECTION VI

INDIAN DEMAND

The demand for CNSL including export demand is estimated to be around 10,000 tonnes per annum.

The estimated growth rate in demand is 7 to 8% per annum
SECTION - VII
MANUFACTURING PROCESS AND TECHNOLOGY SOURCE

7.1. Manufacturing process

Cashewnut Shell Liquid extracted with low boiling petroleum, contains about 90% Anacardic acid and about 10% Cardol.

Cashewnut shell liquid on distillation, gives the pale yellow phenolic derivative cardanol. Natural cashewnut shell liquid contains 80% Anacardic acid, 10-15% cardol and small amounts of other materials notably the methyl derivatives of cardol.

Many refined extraction techniques have of late been devised.

Expeller method being used in Mangalore area is better than other methods like hot oil bath method, kiln method, etc. as it extracts 90% of the oil.
7.2. Source of technology and Technology developments

Regional Research Laboratory, Tiruvananthapuram

Regional Research Laboratory, Tiruvananthapuram have reported to have developed the technology for the manufacture of cashewnut shell liquid.

(Council of Scientific & Industrial Research)
Industrial Estate P.O.,
Pappanamcode, Thiruvananthapuram-695 019, Kerala.
Phone EPABX : 0471-490811, 490324, 490674, 490224
Fax : (0471) 490186, 491712, 491895
Telex : 0435-232; Telegram : CONSEARCH
E-mail : rrit@sirnetm.ernet.in, root@csrrltrd.ren.nic.in
rrltm@md2.vsnl.net.in

A new method to prepare a transparent resin from Cashewnut shell Liquid.

Regional Research Laboratory, Tiruvananthapuram is reported to have developed the technology for the manufacture of Cashew nut shell liquid.

Regional Research Laboratory have synthesised a novel and cheaper liquid crystalline polyester based on Cashew nut shell liquid that can substitute for polymer fibres and films in speciality applications.

CSNL's utilisation is restricted due to its colour, as only brown-coloured products can be prepared from it impending its competitiveness with synthetic resins.

Research is under way at the Regional Research Laboratory (RRL), Thiruvananthapuram, to evolve a colourless resin from the cashewnut shell liquid.

The method developed under a sponsored project by Vijayalexmi Cashew Company, Kollam, could be used to prepare clear coatings and paints of all colours. The coatings can be used in the electronic and automobile industry, adhesives and polymer support materials.

The scientists successfully produced polymerisable monomers cardanyl methacrylate (CMA) which after bulk polymerisation with appropriate chemicals gave polycardanyl methacrylate.

Evaporation of the solvent gave transparent films and uniform-sized transparent beads and aqueous emulsions were produced through other methods.
##Major plant and machinery

<table>
<thead>
<tr>
<th>Name of the equipment</th>
<th>Name of the supplier</th>
</tr>
</thead>
</table>
| Extractor             | Adam Fabriwork P. Ltd.,  
203, Raiguru Appartments  
New Nagardas Road,  
Andheri (E), Mumbai-400 069  
Super Scientific Works P.Ltd.,  
E-70-71, Sardar Estate,  
Ajwa Road, Baroda-390 019 |
| Distillation column   | Chemac Equipments Pvt. Ltd.  
Regd. Office & Factory:  
M.J.D'Souza Compound,  
Safed Pool, Saki Naka  
Mumbai-400 072  
Hyderabad Met Chem. Pvt. Ltd.,  
34, C.I.E., Phase II,  
Gandhinagar, Opp. IDPL Colony  
Hyderabad-500 037 |
| Evaporator            | Excel Industrial Services  
White House, D-111/8,1st Main Road,  
Anna Nagar (East)  
Chennai-600 102  
Alfa Laval Saunders (India) Ltd.,  
No.18, Gill Nagar, Fist Street  
Chennai-600 094 |
| Boilers               | Cethar Vessels Ltd.,  
No.4, Dindigul High Road,  
Trichy  
Firetech Boilers Pvt. Ltd.  
No.211, 2nd Cross,  
38th Main, B.T.M. Layout  
2nd Stage, Bangalore-68 |
RAW MATERIAL REQUIREMENTS AND AVAILABILITY

Botanical name of Cashew: Anacardium occidentale L

Area of growth of Cashew tree  Coastal areas of Asia and Africa. Mozambique, India and Brazil

Specification of Cashewnut shell

The shell is about 0.3 cm thick, having a soft feathery outer skin and a thin hard inner skin. Between these skins is the honeycomb structure containing the phenolic material known as CNSL. Inside the shell is the kernel wrapped in a thin skin known as the testa.

Composition of cashewnut

The nut consists of the following

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kernel</td>
<td>20 to 25%</td>
</tr>
<tr>
<td>Kernel liquid</td>
<td>20 to 25%</td>
</tr>
<tr>
<td>Testa</td>
<td>2%</td>
</tr>
<tr>
<td>Others</td>
<td>Rest being the shell.</td>
</tr>
</tbody>
</table>

The raw material for the manufacture of CNSL is the Cashew. The details of the availability of Cashew is given below:

Over the past 25 years, the area under the Cashew crop has increased with an average productivity of about 635 kg per hectare. The productivity in Maharashtra is the highest with 1300 kg per hectare followed by 1178 kg per hectare in Kerala.

Native to Brazil, the cashew tree grows in the coastal areas of Asia and Africa, Mozambique, India and Brazil are the main producers of cashewnut and Cashewnut shell liquid in the world. In India, Kerala tops in area under cashew cultivation followed by Tamil Nadu, Karnataka and Andhra Pradesh. Other states which produce cashewnut and Cashewnut shell liquid are Goa, Maharashtra, Orissa, West Bengal, Tripura and Pondicherry.

The Shell is about 0.3 cm thick, having a soft feathery outer skin and a thin hard inner skin. Between these skins is the honeycomb structure containing the phenolic material known as Cashewnut shell liquid. Inside the shell is the kernel wrapped in a thin skin known as the testa.

During the Eighties, with the implementation of a World Bank-aided project in four states, namely, Andhra Pradesh, Kerala, Karnataka and Orissa, the farmers became
aware of the horticultural practices in cashew cultivation. The production which was 2.1 lakh tonnes during 1983-84, rose steadily to above 4 lakh tonnes in nineties.

**Major Cashew producing states**

<table>
<thead>
<tr>
<th>States</th>
<th>Area in hectares</th>
<th>Production in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerala</td>
<td>120000</td>
<td>100000</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>103500</td>
<td>60000</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>124100</td>
<td>500000</td>
</tr>
<tr>
<td>Orissa</td>
<td>108600</td>
<td>45000</td>
</tr>
<tr>
<td>Karnataka</td>
<td>87000</td>
<td>35000</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>80500</td>
<td>30000</td>
</tr>
<tr>
<td>Goa</td>
<td>52000</td>
<td>25000</td>
</tr>
</tbody>
</table>
GLOBAL SCENARIO

**World production of Cashewnuts**

Around one million tonnes per annum

Cashews are grown around the world, chiefly within a band 10 degrees north and south of the equator. Major producers are located in Brazil, India and Africa.

Cashewnut shell liquid is used in almost every automobile in the world. It provides heat resistance as an additive in brake linings. The product has been around since the 1920s or 30s.

Worldwide consumption of cashew nut oil by the auto industry is estimated to be about 25000 tonnes per year.

Palmer is the largest buyer worldwide of cashewnut shell liquid, which it processes further via a separation process.

Cardolite is the largest buyer in North America

**Global development**

**Ciba polymer**

In a move to expand its epoxy coatings product offerings, Ciba polymer has signed a letter of intent with Worcester, Pennsylvania based Palmer International Inc., For the development of cashew oil and its derivatives. In doing so, it will take on cardolite corp., The originator of and leader in Phenalkamine coatings technology.

Globally, Newyork, us based cardolite competes against palmer in the brake linings business, but has an edge on coating applications. However, its Phenalkamines do compete against a wide variety of curing agents marketed by Ciba and others.

**Three new products**

Ciba polymer are now offering three new products based on the cashew nut shell oil and have begun a number of R&D projects.

Ciba’s alliance with palmer international will benefit both companies. Palmer is one of north America’s leading suppliers of cashew nut shell oil, which is used to advance the state of the art in epoxy hardeners.

**SECTION X**

25
DISCUSSIONS ON ECONOMIC CAPACITY, PROJECT COST AND PROFITABILITY PROJECTIONS

Economic capacity : 300 tonnes per annum  
Project cost : Rs. 65 lakhs

Assessment of project cost
1. Land

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>Cost Rs.in lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Cost of land of one acre at Rs.5.5 lakh per acre</td>
<td>2.75</td>
</tr>
<tr>
<td>1.2</td>
<td>Cost of levelling, laying internal roads/fencing and compound wall</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>3.03</strong></td>
</tr>
</tbody>
</table>

2. Building

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>Cost Rs.in lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Factory building of area 420 sq.m. at Rs.3200/sq.m.</td>
<td>5.12</td>
</tr>
<tr>
<td>2.2</td>
<td>Non-factory building of area 50 sq.m. at Rs.4500/sq.m.</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>7.82</strong></td>
</tr>
</tbody>
</table>

Cost of Plant & Machinery

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>Cost Rs.in lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Cost of basic plant and machinery</td>
<td>15.5</td>
</tr>
<tr>
<td>3.2</td>
<td>Instrumentation and control</td>
<td>1.15</td>
</tr>
<tr>
<td>3.3</td>
<td>Pipelines and valves</td>
<td>1.6</td>
</tr>
<tr>
<td>3.4</td>
<td>Structurals for erection</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>19.05</strong></td>
</tr>
<tr>
<td>3.5</td>
<td>Octroi, excise duty, sales tax, etc. at 12%</td>
<td>2.3</td>
</tr>
<tr>
<td>3.6</td>
<td>Packaging and insurance charges (2%)</td>
<td>0.38</td>
</tr>
<tr>
<td>3.7</td>
<td>Transportation charges (2%)</td>
<td>0.38</td>
</tr>
<tr>
<td>3.8</td>
<td>Machinery stores and spares (2%)</td>
<td>0.38</td>
</tr>
<tr>
<td>3.9</td>
<td>Foundation charges (2%)</td>
<td>0.38</td>
</tr>
<tr>
<td>3.10</td>
<td>Installation charges (2%)</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td><strong>Total cost of plant and Machinery</strong></td>
<td><strong>23.25</strong></td>
</tr>
</tbody>
</table>

4. Technical know-how fees : Rs.2 lakhs
5. Miscellaneous fixed assets

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>Cost Rs.in lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.</td>
<td>Electrification</td>
<td>2.9</td>
</tr>
<tr>
<td>5.2.</td>
<td>Steam boiler and auxillaries</td>
<td>3.5</td>
</tr>
<tr>
<td>5.3.</td>
<td>Water storage tank, borewell etc.</td>
<td>0.76</td>
</tr>
<tr>
<td>5.4.</td>
<td>Fuel storage tank</td>
<td>0.76</td>
</tr>
<tr>
<td>5.5.</td>
<td>Laboratory equipment</td>
<td>0.43</td>
</tr>
<tr>
<td>5.6.</td>
<td>Office machinery &amp; equipment</td>
<td>0.76</td>
</tr>
<tr>
<td>5.7.</td>
<td>Material handling equipment, packaging machinery, weigh balance, etc.</td>
<td>0.76</td>
</tr>
<tr>
<td>5.8.</td>
<td>Diesel generator</td>
<td>4.43</td>
</tr>
<tr>
<td>5.9.</td>
<td>Effluent treatment</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>15.62</strong></td>
</tr>
</tbody>
</table>

6. Preliminary & Pre-operative expenses:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>Cost Rs.in lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.</td>
<td>Preliminary expenses</td>
<td>0.7</td>
</tr>
<tr>
<td>6.2.</td>
<td><strong>Pre-operative expenses:</strong></td>
<td></td>
</tr>
<tr>
<td>6.2.1</td>
<td>Establishment</td>
<td>0.55</td>
</tr>
<tr>
<td>6.2.2</td>
<td>Rent rates and taxes</td>
<td>0.77</td>
</tr>
<tr>
<td>6.2.3</td>
<td>Travelling expenses</td>
<td>1.2</td>
</tr>
<tr>
<td>6.2.4</td>
<td>Interest and commitment charges on borrowings</td>
<td>1.85</td>
</tr>
<tr>
<td>6.2.5</td>
<td>Insurance during construction period</td>
<td>1.3</td>
</tr>
<tr>
<td>6.2.6</td>
<td>Other preoperative expenses and deposits</td>
<td></td>
</tr>
<tr>
<td>6.2.7</td>
<td>Interest on deferred payment</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6.37</strong></td>
</tr>
</tbody>
</table>

7. Provision for contingency 3.5

8. Working capital margin 3.2

9. Total project cost Rs. 65 lakhs

10. Means of Finance

Promoter's contribution Rs.26 lakhs
Term loan from financing institutions Rs.39 lakhs
Total project cost Rs.65 lakhs

11. Financial statements
## Cost of production

<table>
<thead>
<tr>
<th></th>
<th>Variable cost</th>
<th>Rs. in lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material and utilities</td>
<td>9.65</td>
<td></td>
</tr>
<tr>
<td>Spares and maintenance</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Selling expenses</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td><strong>Total variable cost (A)</strong></td>
<td><strong>13.45</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fixed cost</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and wages</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Interest on term loan and working capital loan</td>
<td>8.75</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>3.73</td>
<td></td>
</tr>
<tr>
<td>Administrative expenses</td>
<td>1.44</td>
<td></td>
</tr>
<tr>
<td><strong>Total fixed cost (B)</strong></td>
<td><strong>22.92</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total cost of production (A+B)</th>
<th>36.37</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Selling price per kg. (in Rupees)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Annual sales turnover</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Net profit before tax (E -C)</td>
<td>11.63</td>
</tr>
<tr>
<td></td>
<td>Breakeven point in %</td>
<td>66.33</td>
</tr>
</tbody>
</table>
## SECTION XI

**SWOT ANALYSIS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>Ready availability of the product</td>
</tr>
<tr>
<td>Weakness</td>
<td>Lack of R&amp;D thrust</td>
</tr>
<tr>
<td>Opportunity</td>
<td>Exports</td>
</tr>
<tr>
<td>Threat</td>
<td>Substitution possibility</td>
</tr>
</tbody>
</table>
SECTION XII

FACTORS INFLUENCING THE POSITION FOR A NEW INDUSTRY AND RECOMMENDATION

India is, the large producer and processor of Cashewnut shell in the world and therefore, has special advantages with regard to the CNSL industry.

Indian CNSL industry is still operated mostly as small scale units, lacking in R&D thrust and application development efforts.

The export opportunity for CNSL would substantially improve, if Indian units would produce various grades of product for meeting the specific requirement of application sector.

CNSL should be considered as thrust product for export.