



SRI DEVI LIQUIDS

(A Unit of Sri Devi Group)

Product: CNSL

Rajahmundry Road, Peddapuram-533437, East Godavari District, Andhra Pradesh

www.sridevigroup.com , sdevigroup@gmail.com

TECHNICAL DATA SHEET (TDS)

Introduction

Cashew nut shell liquid (CNSL) is one of the sources of naturally occurring phenols. It is obtained from the shell of a cashew nut. About 30-35% CNSL is present in the shell, which amounts to approximately 67% of the nut.

CNSL is traditionally obtained as a by-product during the process of removing the cashew kernel from the nut. The processes used are mainly hot-oil and roasting in which the CNSL oozes out from the shell.

Composition

Natural (i.e. cold, solvent extracted) CNSL contains approximately 70% anacardic acid (Fig 1), 18% cardol, and 5% cardanol, with the remainder being made up of other phenols and less polar substances. As can be seen in Figure 1, anacardic acid, cardanol and cardol consist of mixtures of components having various degrees of unsaturation in the alkyl side-chain.

Figure 1: Structures of Anacardic acid, Cardanol and Cardol

In technical (i.e. heat extracted) CNSL, the heating process leads to decarboxylation of the anacardic acid to form cardanol. Typically, the composition of technical CNSL is approximately 52% cardanol, 10% cardol, 30% polymeric material, with the remainder being made up of other substances.

The technical CNSL is often further processed by distillation at reduced pressure to remove the Polymeric material. The composition of distilled technical CNSL is approximately 78% cardanol, 8% cardol, 2% polymeric material and the remainder other substances.



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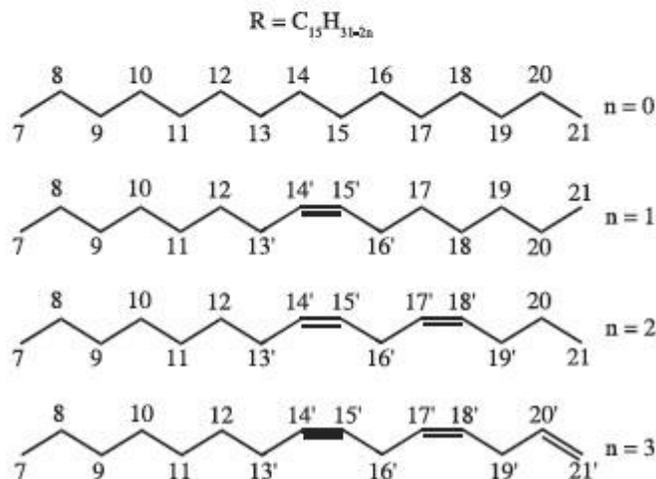
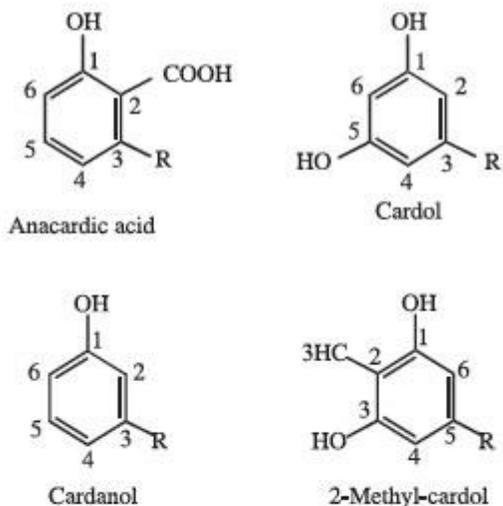


Figure 1. Structure of main components of CNSL^[16].

Commercial Applications

CNSL resins have been used extensively in the manufacture of friction-resistant components in applications such as brake and clutch linings. These resins are used as binders for friction ingredients and also as friction ingredients themselves in the form of fine dusts obtained from the completely cured resins.

CNSL-aldehyde condensation products and CNSL-based phenolic resins are used in applications such as surface coatings, adhesives, varnishes and paints. Various polyamines synthesised from



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CNSL or cardanol are used as curing agents for epoxy resins. CNSL and its derivatives have been used as antioxidants, plasticisers and processing aids for rubber compounds and modifiers for plastic materials. Resins based on the reaction products of cardanol phenol and formaldehyde are used to improve the resistance of rubber articles to cracking and ozone. CNSL, cardanol and cardol are all used to provide oxidative resistance to sulfur-cured natural rubber products. Cardanol, CNSL or sulfurated CNSL is added to rubber gum stock or nitrile rubber to improve the processability, mechanical properties and resistance to crack and cut properties of the vulcanisates.

A number of products based on CNSL are used as antioxidants, stabilisers and demulsifiers for petroleum products. Metal xanthates of partially hydrogenated, sulfurised cardanol is used to lower the pour point of lubricating oils as well as acting as antioxidant and anticorrosive properties. Soluble metal derivatives of CNSL are used to improve the resistance to oxidation and sludge formation of lubricating oils. Oxidised CNSL and its derivatives are used as demulsifying agents for water in oil type petroleum emulsions.

CNSL can be extracted by the expeller method but the oil has to be heated after extraction to convert anacardic acid to cardanol. The expelled and heated CNSL will have less amount of polymerised CNSL. However, if there is a requirement for pure monomers, the best source will be solvent extracted CNSL. Each component again is a mixture of four structurally related monomers, the difference being only in the degree of unsaturation. Thus, cardanol is a mixture of a four components: saturated (~5%), monoene (~49%), diene(16.8%) and triene (29.3%). (This makes the chemistry of addition polymerisation essentially complex). Thus, CNSL contains a total of 16 components, which makes it a complicated system.

Cost Effective Modern Materials

In the search for the cost effective modern materials, CNSL and its products have a significant role to play. Being renewable, it offers much advantage over synthetics. Its versatility stems from its innumerable applications in many areas. Recent research has shown that the constituents of CNSL possess special structural features for transformation into speciality chemicals and high value polymers. This involves a value addition of many orders of magnitude and the chemical transformation provides 100% chemically pure products. Thus, CNSL offers vast scope and opportunities for the production of speciality chemicals, high value products and polymers.



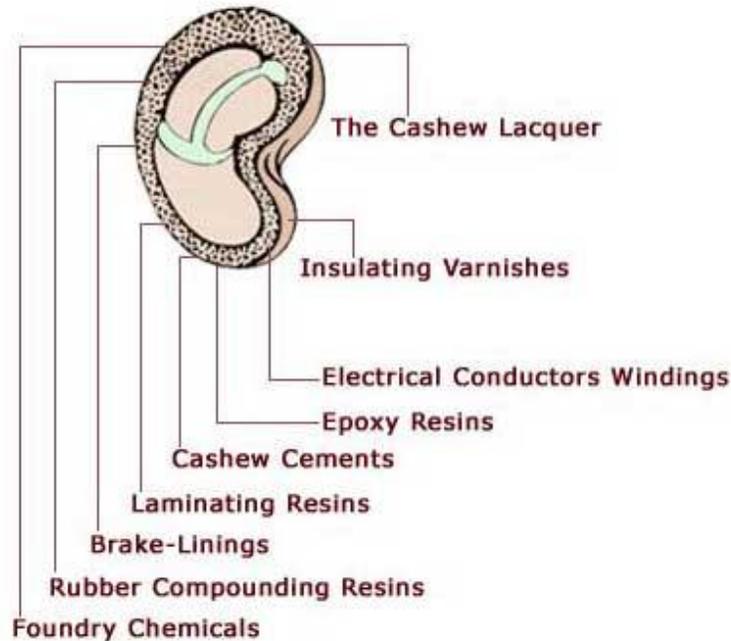
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Advantages of CNSL based Polymers

- Improved Flexibility and reduced brittleness.
- Solubility in Organic Solvents.
- Improved Processability.
- Low Fade Characteristics for Friction.
- Resistance to 'Cold Wear'.
- Good Electrical Resistance.
- Better Water Repellence.
- Improved alkali and acid resistance.
- Compatibility with other polymers.
- Antimicrobial Property.
- Termite and Insect Resistance.
- Structural Features for Transformation into High Performance Polymers.



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Polymerisation Characteristics of CNSL

CNSL can be polymerised by a variety of methods :

- Addition Polymerisation through the side chain double bonds using cationic initiators such as sulphuric acid, diethylsulphate etc.
- Condensation Polymerisation through the phenolic ring with aldehydic compounds.
- Polymerisation after Chemical Modification to introduce speciality properties.
- Oxidative Polymerisation.
- Various Combinations of the above.

Industrial Significance of CNSL

- Low Cost Phenol.
- Versatility in Polymerisation and Chemical Modification.
- Possibilities for Development of High Performance Polymers.
- Property advantage over phenolics in certain applications such as impact resistance, flexibility, faster heat dissipation etc.

Reactivity

CNSL undergoes all the conventional reactions of phenols. Cardanol differs from phenol only in the C15 side chain. It undergoes the well known formaldehyde condensation reaction of phenols that gives rise to phenolic polymers. Moreover, it can be polymerised through the unsaturation in the side chain although the bulky nature of the side chain restricts the molecular weight attainable to oligomers. One of the significant advantage of the cardanol is its amenability to chemical modification to effect desirable structural changes so as to get specific properties for making tailor-made polymers of high value. Thus, structural changes could be effected at the hydroxyl group, on the aromatic ring and on the side chain.

Cardanol

Distillation of CNSL under reduced pressure gives cardanol. The residue will be rich in cardanol and is generally known as residol, which is conveniently used in the preparation of friction dust for brake linings, and also in rubber compounding formulations.



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Other Derivatives from CNSL

Other derivatives of CNSL are used in the preparation of surface-active agents by:

Sulfonation
Antioxidants
Lubricants
Bactericides, Fungicides and Disinfectant
Insecticides, Pesticides and Herbicides
Drugs
Dyestuff





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PROPERTIES OF CNSL

S.No	Characteristic	Specification
1	Appearance	Reddish Brown liquid
2	Specific Gravity @ 30°C	0.93 – 0.96
3	Viscosity @ 30°C Flow cup no.4 (second)	100-150 cps 35-45
4	Moisture content	1% (max)
5	Ash content	1% (max)
6	Insolubles in Toluene (%)	1% (Max)
7	Acid Value (mgKOH/gm)	<2
8	Iodine Value (WIJS)	240 – 290
9	Hydroxyl Value (mgm KOH/gm)	170-250
10	Saponification Value	18 – 30
11	Alkaline pH	8-10



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Certificate of Components

Product Name : Cashew Nut Shell Liquid (CNSL)

Chemical Name(IUPAC or CA Index Name)	CAS No	Content(%)
Anacardic acid	16611-84-0	70%
Cardol	57486-25-6	18%
Cardanol	37330-39-5	5%
2-Methly-Cardol	8007-24-7	7%