



“A REVIEW ON LIQUID CRYSTALS”

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ABSTRACTS:

Liquid crystal have two states of matter. e. Isotropic liquid and crystal line solid phase. Liquid crystals are flow like to the liquid, but molecules way in a crystalline .In 1888, Friedrich Reinitzer discovering the "Liquid crystals phase". Liquid crystals also known as 'mesophase'. It is classified in a two ways i.e. i) Thermotropic liquid crystals (non amphiphilic liquid) ii) Lyotropic liquid crystals (amphiphilic liquid crystals). The thermotropic liquid crystals depend on a temperature and variation in a liquid state. While lyotropic is a solution of the compound in their solvents. Lyotropic is used a multiple compound system as compared to thermotropic. Liquid crystals play a major role in modern technology. The main importance of the liquid crystals is a development of the targeted drug delivery system. In liquid crystals, brief information about its classification, history, properties, advantages, disadvantages as well as its application.

Keywords: History, liquid crystals, mesophase, nematic, cholesteric liquid crystal, application.

INTRODUCTION:

History Of Liquid Crystals

In 1888, Friedrich Reinitzer was observed the material as the p - cholesteryl benzoate had two melting points. In Reinitzer's experiments, solid sample of p - cholesteryl benzoate have increased temperature, to observe the crystals had change in to the lazy liquid. Again in increased temperature of the material, to change in to the clear as well as transparent liquid. His discovering then the phase of matter i.e. "Liquid crystals phase"⁽⁴⁾⁽⁹⁾.



Table 1: Centres of liquid crystals Research

Country	City (center)
India.	Bangalore
Japan	Display Industry
Germany	Halle
England	Hull
U.K.	Kent State

Liquid Crystals

Liquid crystals are defined as "orientationally ordered crystals " or " positionally ordered crystals " that combines the properties of both crystalline (optical & electrical anisotropy) and the liquid (molecular mobility and fluidity) state.⁽¹⁾⁽³⁾

OR

The phase which is intermediate of solid and liquid and which has properties between true solid and true liquid (clear liquid) is called as liquid crystals.

- Liquid crystals are also called as "mesogen " or " mesophase".
- They are optically anisotropic.

The liquid crystals are the irproperties between the conventional liquid and solid crystals. Liquid crystals is flow of like liquid, but molecules way in a crystalline. It is composed of rodlikemolecularstructure,longaxisofrigidnessandstrongdipoleandeaspolarizablesubstituents.

Diagram:-

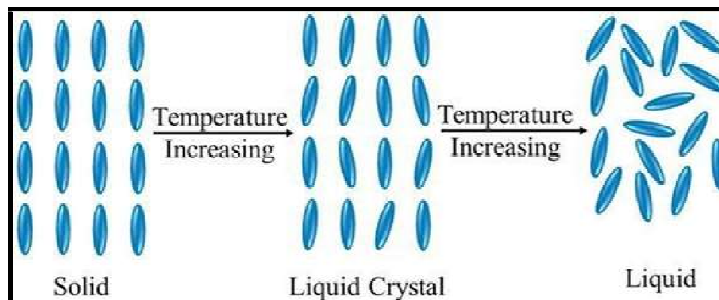


Figure.1:Molecular arrangement of solid, liquid crystal and liquid.(6)

The liquid crystals is a two states of matter i.e.isotropic and liquid. Liquid crystals is also called as 'mesophase'.

Liquidcrystalshavetwoparts:

- 1) Flexible side:-(called as mesogen)
- 2) Centralrigidpart:-(called as spacer)

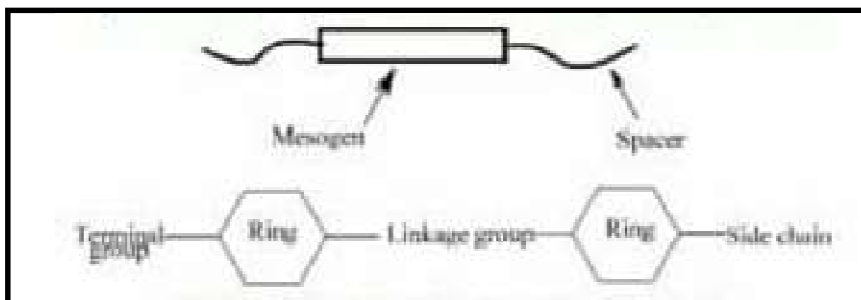


Figure 2: Typical rod-like shape of a liquid crystal molecule.

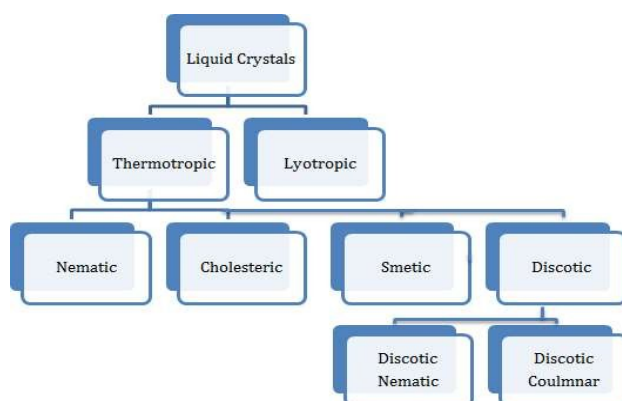
The two or more rings connected with central linkage group. Liquid crystal, molecules havestrong molecular interaction i.e. $\pi - \pi$ interaction because, molecules areparallel to eachother.

Objectives:

- Tostudythehistoricalbackground.
- Informationofpharmaceuticalliquidcrystalstechnology.
- Tostudytheliquidandsolidpropertiesofliquidcrystals.
- Improvetheefficacyandstabilityofdrug.
- Tostudytheliquidcrystalsapplications.

CONTENT:

▪ Classification Of Liquid crystals (4)

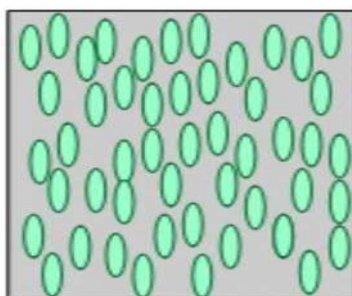


Thermotropic Liquid crystals (11)(15):

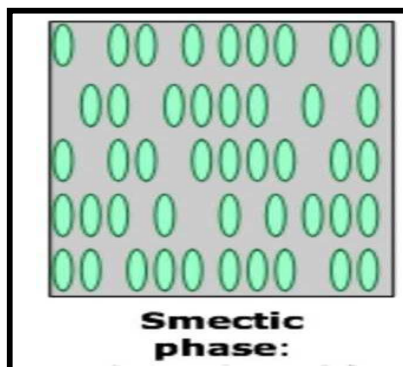
- Thermotropic liquid crystal like are temperature variant.
- They also known as non amphiphilic liquid crystals.
- They show liquid crystal line properties.
- They does not contains ionized, highly polar hydrophilic group and dipolar groups. i.e. - C≡N
- There are four types of thermotropic liquid crystals.
- Thermotropic behavior means the compounds are liquid
- crystalline within a defined temperature range, below this range compounds are crystal line and above it compounds are isotropic liquids.
- Thermotropic liquid crystal line compounds also require no solvent.
- crystalline compounds also require no solvent
- crystalline and above it compounds are isotropic liquid
 1. Nematic liquid crystals
 2. Sematic liquid crystals
 3. Cholesteric liquid crystals
 4. Discotic liquid crystals

1) Nematic liquid crystals:-

- 2) In anematic phase (the term means "thread-like") the molecules are aligned in the same direction but are free to drift around randomly.
 - Orientation order is present.
 - Position order is absent.
 - It is simplest form of liquid crystals.
 - Axial arrangement of molecules with long axes.
 - One dimensional occur.
 - They move up and down direction.
 - Commonly used in telescope lens to clear image.
 - Molecules arranged parallel.
 - Ex. Cynobiphenyl

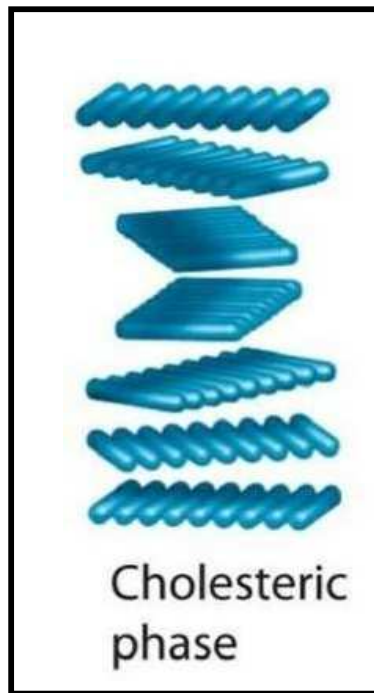
**Nematic phase:****Figure 3: Nematic Liquid Crystal (5)****3) Sematic liquid crystals:-**

- In anematic phase (the term means "thread-like") the molecules are aligned in the same direction but are free to drift around randomly.
- The slippery, thick residue found at the bottom of soap dishes.
- Orientation order present.
- Position order present.
- They show the sliding property because they are arranged in layer types.
- They show characteristics like lubricant.
- Sematic liquid crystals are used along with nematic liquid crystals to produce LCD screens.
- This phase can be reached at lower temperature than Nematic phase.

**Smectic phase:****Figure 4: Smectic Liquid Crystal (5)**

4) Cholesteric liquid crystals:-

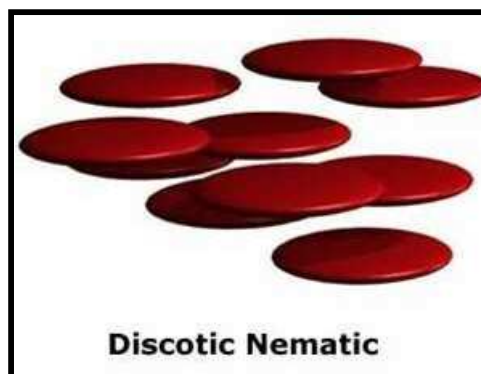
- Cholesteric liquid crystals also known as chiralnematic liquid crystals.
- This phase shows the twisting of the molecules perpendicular to the director.
- Orientation or order as well as position order of molecule is absent.
- Changing the colour with different temperature.
- They can rotate in 360 degrees, because its rotator power is very high.
- They complete its one rotation is known as pitch, temperature increased then speed of rotation is low.
- Pitch is inversely proportional to the temperature.
- Ex. Cholesterol benzoate.
- They used as sensor as well as thermometer.

Figure 5: Cholesteric Liquid Crystal⁽⁷⁾**5) Discotic liquid crystals:-**

- Discotic liquid crystals phase are further two types.
 - A. Discotic nematic liquid crystals.
 - B. Discotic columnar liquid crystals.

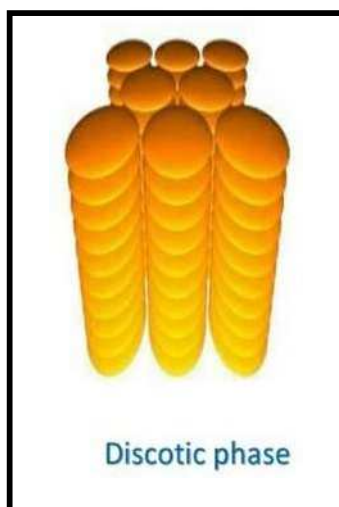
A) Discotic nematic liquid crystals:-

- Structure looks like coin.
- Orientation order is present.
- Positional order is absent.

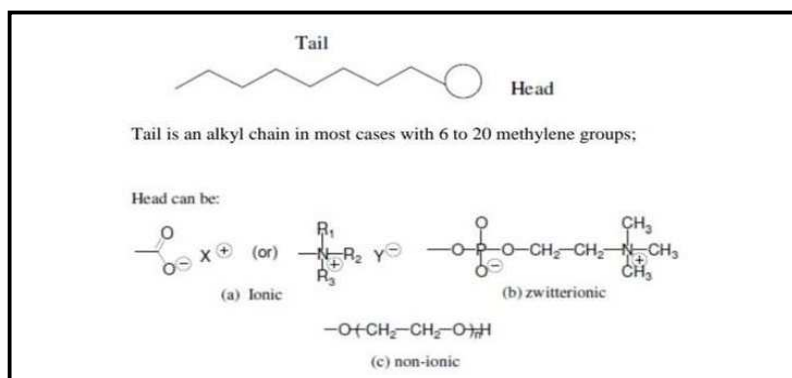
Figure 6: Discotic Nematic Liquid Crystal⁽⁴⁾

B) Discoticcolumnarliquidcrystals:-

- Discoticcolumnar liquid crystal are different from the previous types because they are shaped like discs instead of long rods.
- Orientation order is present.
- Position order is present.

Figure 7: Discotic Columnar Liquid Crystal⁽⁴⁾**➤ Lyotropic liquid crystals^{(15)(9):-}**

- This phase is also called as 'Amphiphilic liquid crystals'.
- Liquid crystal phase formed by dissolving the compound in an adequate solvent (under given concentration and temperature condition) are known as lyotropic liquid crystals.
- Temperature as well as solvent variant.
- They are optically inactive.
- They do not use electronic display.
- Molecules show their different characteristics on the different molecular region.
- Molecules have two regions
 - i) polar (hydrophilic)-Head group.
 - ii) nonpolar (hydrophobic)-Tail.
- e.g: Soap dissolved in water to form liquid crystals.

Figure 8: Lyotropic Liquid Crystal⁽⁵⁾