RUBBER

Rubber or Elastomers are high polymer which sustain or can under very large elongations at relatively low stresses.

Elasticity to rubber is caused by the lengthening and shortening of these springs of polymeric chains when stretching force is applied and released respectively.

★ Natural Rubber

"Natural rubber is a high molecular weight linear hydrocarbon polymer which exhibits elasticity and other rubber like properties."

- Natural rubber is made from a milky emulsion (white liquid) called 'latex' obtained by cutting narrow strips from the bark of the rubber trees such as Hevea, Gutta-Percha, Balata, Guayule, etc.
- These trees are found in tropical and semi-tropical countries such as Malaysia, Indonesia, Brazil, Ceylon (Sri Lanka), India.
- Natural rubber contains 30-40% rubber solids, 55-60% water depending upon the age of tree.
- The solid material is isoprene.

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$$n\left[-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_2-\right] \xrightarrow{\text{Polymerisation}} \left[-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_2-\right]_n$$

Isoprene → Polyisoprene (rubber)

* Treatment of Latex (Natural Rubber processing)

- The latex is diluted contain about 30-60% of rubber and filtered to remove the dist.
- The latex is then coagulated by addition of coagulants such 5% solution of acetic acid or 90% formic acid.
- Potassium or aluminium alum are also used as coagulants.
- When weak solution of acetic or formic acid is added to latex, it makes particles of rubber in either strings or clots which rises to the top. This process of separating rubber particles from latex is called coagulation.
- After coagulation, the whole mass is left for several hrs, then rubber is coagulated to soft white mass known as coagulum.
- The coagulums are then separated from liquid by squeezing in the rolls.
- The sheet of rubber then washed and

dried to give crude rubber, the surface of which resemble to crepe paper, hence it is known as crepe or raw rubber.

Drawbacks of Natural Rubber

1. During summer, the raw rubber becomes soft and sticky, while in cold it becomes hard and brittle.
2. It has low tensile strength (210 kg/cm²).
3. It is too weak to be used in heavy duty operation.
4. On stretching, it undergoes permanent deformation
5. It has large water absorbing capacity.
6.

~~Vul~~ Vulcanisation of Rubber with Chemical Rkn.

To improved the properties of crude or raw rubber, it is compounded with some chemicals like sulphur, Hydrogen sulphide benzoyl chloride etc.

The Rkn with Sulphur

- The process consists of heating the crude rubber with sulphur to a high temperature then the sulphur combines with double bond in the rubber molecule of different rubber strings.

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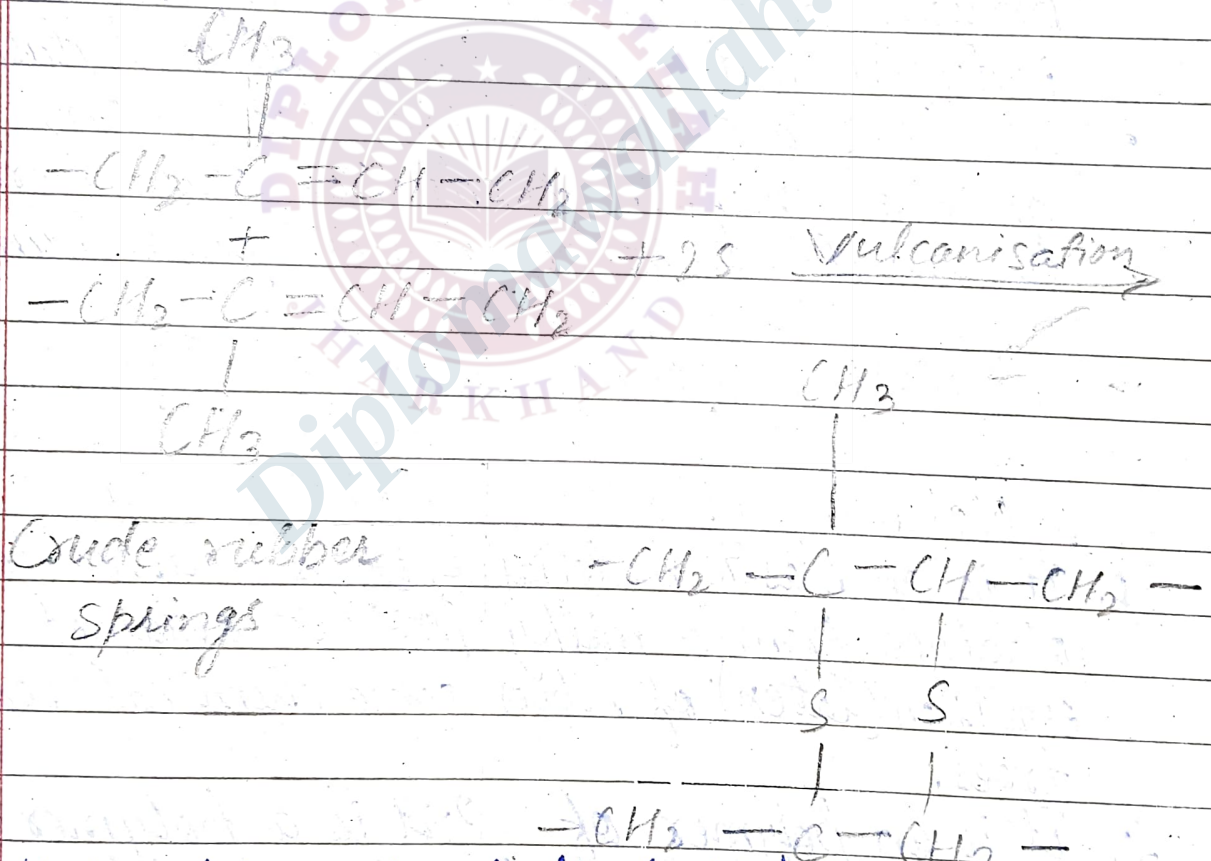
- Vulcanisation brings stiffness of the rubber by cross-linking and consequently preventing intermolecular movement or sliding of rubber springs.
- The extent stiffness or loss of elasticity of vulcanised rubber depends upon the amount of sulphur added.
  For eg:- a tyre contains 3-5% sulphur but a battery case rubber contains 30% sulphur.



- Vulcanite or ebonite (hard rubber) contains 52% sulphur.
- The vulcanite is tough, abrasion resistance, can be sawn, drilled and polished and extremely good electrical insulation properties.

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☆ Synthetic Rubber

"Synthetic rubber is any vulcansible artificially prepared rubber like product, be stretched to 300% or more of its original length, but returns rapidly to its approximate original shape and dimension when the stretching force is released"

- The development of automobile industry brought a revolution not only in petroleum industry but also in the rubber industry.
- At the end of Fourth Five year plan, the artifical rubber production was increased to about 1,20,000 tonnes per annum.

✱ Distinction between Natural and Synthetic rubber

Natural Rubber	Synthetic Rubber
1. It is an elastic material obtained from a milky emulsion (latex) of rubber trees.	1. It is a rubber-like product obtained by some chemical reaction.
2. It is an polymer of isoprene $(C_5H_8)_x$ molecule.	2. It is a polymer of substances having unsaturated nature.
3. It is non-resistant to oxidation.	3. It is highly-resistant to oxidation.

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4. It becomes soft and sticky by application of heat.	4. It does not become soft and sticky by application of heat.
5. Its tack property is high.	5. Its tack property is low.
6. It is soluble in organic solvents.	6. It is insoluble in organic solvents.

NOTE:- At present, the following five types of synthetic rubber are in large-scale use:-

1). Buna-S, (2). Buna-N (3). Butyl Rubber.
4). Neoprene 5). Thiokol.

Four Important Properties of Synthetic Rubber:-

1. Elasticity:- "Elasticity is the property by virtue of which a material undergoes deformation under stress and regains its original shape on removal of the stress."

Elasticity is opposite of plasticity and is measured by measuring plasticity. It is an elastomer during its processing in factory if elasticity is high, it requires excessive power and time for processing.

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2. Tack:- "Tack is the special characteristic of rubber by virtue of which two or more surfaces can stick or adhere to each other."

- Tack can be increased by making the surface fresh by treating with some solvent.
- Takk can be used to make composite rubber articles like tyre.

Synthetic rubber generally lack of this property.

3. Abrasion - Resistance:- It is a process of wearing of surface by friction.

"The property of resisting wearing away of a surface by friction is known as abrasion resistance."

- It is measured in machines in which an abrasive material is rubbed against rubber.
- The loss in volume is measured directly and it in a definite period denotes the loss on abrasion.
- The greater the loss, less is abrasion resistance.
- This property is used in rubber linings.

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4. Stress - Strain (Tensile strength) :- A dumb-bell shaped piece of synthetic rubber is cut with a die. One narrow portion, make two marks one inch apart then placed it in the machine and stretched until it breaks. The load at which it breaks is its 'tensile strength'. This property is used for V-belts and conveyor belts.

Dumb-bell shaped piece of synthetic rubber.

5. Rebound :- It is the measure of resilence i.e, ability to absorb energy and return without permanent deformation of a synthetic ~~fiber~~ rubber.

6. Hardness :- It is the ability of the rubber to withstand wear and abrasion and resist the penetration.

Engg. Application of Rubber

i) It is used for making rubber bands, tubes of bicycles, automobiles and aeroplanes, golf balls etc. due to elasticity, strength and toughness.

ii) It is used for making bicycles, aeroplane tyres, soles and heels for shoe, conveyor belts, v-belts, shock-absorber etc. due to excellet abrasion resistance properties.

iii) It is used as an insulating coating for wires and cables used for electrical power transmission also used in switch board pannel, plugs, sockets etc. due to resistance of electricity.

iv) Sponge rubber is used in shock absorbing cords, and bands for helmets and goggles, toys and sport's goods due to good shock absorbing property.

v) It is used for sealing refrigerators, cabinet doors, cookers, auto clares etc. due to hardness of rubber.

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THERMAL INSULATING MATERIALS

"The materials which are used to prevent the flow of heat are known as thermal insulators"

- It is used to prevent the flow of heat.
- E.g:- Cold storage refrigerators, boilers, ovens, steam carrying pipes, brine pipe lines etc. all need thermal insulators.
- The good thermal ~~conductors~~ insulating have low thermal conductivity.

* Factors affecting the thermal conductivity of Insulators.

1. Moisture:- The thermal conductivity is increased by the presence of moisture in the pores, because of the fact that air in the pores replaced by conducting water vapours.

2. Pores:- The entrapped air or gases in pores have low thermal conductivity so act as thermal insulators by preventing the flow of heat to a great extent, but the transfer of heat by convection increases as the pore volume increases.

Characteristics of Thermal Insulators

i). It should be cheap, fire proof and density is low.
ii). It should be water-proof and hence resist absorption of moisture.
iii). It should possess extremely low thermal conductivity and be odourless during use.
iv). It should be capable of bearing the load applied on it during working.
v). It should withStand the effect of shock and vibrations.

* CLASSIFICATION OF THERMAL INSULATORS

1. Organic insulator:- The naturally occuring materials such as wood, cotton, silk, paper, charcol, powder saw dust, rubber etc which have low density and very large no. of small air pockets.

2. Inorganic insulator:- These include abestos paper, abestos fibre (felted), glass fibre, glass wool, mineral slag fibres, calcium silicate, porus silica etc.

1. **THERMOCOLE**

It is a foamed plastic obtained by blowing air through molten polystrene or polyurethane.

- It is a spongy, porous, foam like in structure.

→ **Property :-**

i) Its density and thermal conductivity is low ($22 kg/m^3$) and ($0.27 kcal/m^2/^oC/hr$) respectively.
ii) It is quite strong, extremely light.
iii) It is chemically inert and resists ageing.
iv) Electrical conductivity is also low and can be used up to 55^oC.

→ **Uses :-**

i) It is used as an ideal packing material for delicate electrical and electronic equipments.
ii) It is used as a heat insulator in refrigerator and air conditioning.
iii) It is used for decorative purposes and for protecting screens in radars.

2. GLASS WOOL

It is a fibrous wool like material which is made up of intermingled fine filaments of glass, like ordinary wool.

⇒ Preparation

- Glass filaments are obtained by forcing molten mass of alkali-free glass through sieve holes having the average diameter of 0.0005 cm. continuously.
- The filaments of glass so obtained are thrown over a rapidly revolving drum to get the material in wool-like form.

⇒ Properties

- Its density ~~is low~~, thermal conductivity (about 0.034 kcal/m²/°C/hr), electrical conductivity also low.
- It is a fire-proof and non-combustible.
- It is resistant to chemicals and does not absorb moisture.
- Its tensile strength is about eight times more than steel.

⇒ Uses :-

- It is used in motors, ovens, refrigerators, walls and roofs of houses, because it is soft, heat-proof, fire-proof, flexible and even inset-proof.
- It is also used as filtering materials for corrosive liquids like acids and acidic solutions in industry.
- It is also used in air-filters as dust filtering material.
- It is used for sound and electrical insulation.

3 ASBESTOS

→ Properties

- It is suitable insulator for heat insulation of boiler and for full head lining a board ship.
- Asbestos sheets are durable, fire-resistant, weather-resistant and light in weight.
- They do not require paintings and cost of maintenance is negligible.
- It is also a good insulator.

⇒ Uses

- It is used for roof-covering and damp-proofing for walls and floors.
- It is also used as a filler for natural and synthetic insulating resins.

4. CORK

It is the name given to light bark of an oak tree.

⇒ Properties

- It is light, porous and resist heat and act as an insulating material against heat and electricity.

⇒ Uses

i) It is used as a lining material for cold storage, refrigerators, bottle stopper and packing gaskets.
ii) It is used in floats of fishing nets.
iii) Floor tiles, walls and ceiling are made sound-proof with cork board.

iv). In shoe industry sheet used as a cold filler and cushioning.
v). In water-proof coating, linoleums etc.
vi). In making base for telephones, bulletin boards and sporting equipment grips etc.

Q:- Why Synthetic rubber is important for transporting?

Ans Synthetic rubber is important for transportation because it is durable, flexible and resistant to wear, heat and chemicals. It is used in tyres, seals, hoses, and belts, ensuring safe and efficient vehicle performance.

Q:- What is acid rain? How does it affect?

Ans Acid rain is a type of precipitation that contains high levels of nitric and sulphuric acids. It forms when sulphur dioxide (SO_2) and nitrogen oxides (NO_2) are released into the atmosphere by burning of fossil fuels and react with rain water, oxygen and chemicals.

1. Environmental damage

- Soil:- It depletes the essential nutrients and fertility of soil.
- Water Bodies:- it increases the pH of lakes and rivers, making the water acid and harm the aquatic life.
- Forest:- It damages and ~~weak their~~ Stripping away their nutrients.

2. Structural damage:-

- It corrodes buildings, monuments, infrastructure, especially those made of limestone and marble (e.g. The Taj Mahal).

3. Health effects:-

- Acid rain doesn't directly affect the human health but the the pollutants that cause it (SO_2 and NO_2) contribute to respiratory problems, ~~and degrade~~ like asthma and bronchitis.

4. Economic Impact:- Affects agriculture, fisheries, tourism and production by damaging crops, ~~de~~ reduce fish production and by damaging historical sites.

Q. How to reduce noise pollution?

A. The following are the ways to reduce noise pollution are as:-

i). Limit vehicle noise:- Maintain vehicles, use quieter engines, and promote electric vehicles.

ii). Promote Green Areas:- Parks and green spaces helps absorb sound and reduce noise.

iii). Control Construction Noise:- Use low-noise equipment in construction sites.

iv). Encourage Public Awareness:- Educate people on impact of noise pollution and ways to minimize it.

v). Use sound Barriers:- Plant trees, install soundproof windows, use noise barriers near highways and industries.