

Materials:

1. NATURAL RUBBER (NR):-

Natural rubber is derived from a dried milky liquid which could be obtained by cutting the bark of certain trees (Hevea Brasilliensers)

Hardness: - Hardness varies from sponge to ebonite.

Tensile Strength: - Has good tear and abrasion resistance and high tensile strength with good resistance properties.

Heat Resistance: - Can withstand a continuous service temperature of approximately 60-70°C and when specially compounded than 80°C on the other hand, it remains flexible down to -60°C.

Feature: - It has a fair good resistance to dilute acids and alkalies.

Applications: - Natural Rubber is used in Mountings & Suspension bushings.

2. STYRENE BUTADIENE RUBBER (SBR):-

Natural Rubber's poor resistance to Non - polar oils has given rise to synthetic Rubber. SBR is a copolymer of styrene and butadiene. It is used along with natural Rubber or in place of natural Rubber to a certain degree.

Tear strength: - Tear resistance is slightly less than Natural Rubber.

Abrasion Resistance: - Abrasion resistance is better than Natural Rubber.

Resilience: - Resilience of SBR is less than Natural Rubber.

Heat Resistance: - When specially compounded can stand temperature up to 90°C.

Applications: - SBR is used in manufacture of tires, automobiles parts, weather strips, bumpers and grommets.

3. NITRILE RUBBER (NBR):-

Commonly referred as Nitrile or Buna 'N', it is a copolymer of acrylonitrile and butadiene.

Hardness: - Hardness ranges from 20 shore 'A' to ebonite.

Tensile Strength :- The degree of tensile strength varies but tensile strength is highest when the hardness is between 70 and 80 Shore 'A'

Compression Set :- Very low Compression Set is obtainable when suitably formulated and well cured.

Heat Resistance: - It can withstand a long service at temperatures of 90°C to 100°C. At higher temperatures they behave satisfactorily for several weeks. Maximum working temperature is about 120°C

Flexibility: - It remains flexible at -30°C and -45°C when suitably formulated.

Feature: - Is its excellent resistance to oil and liquid fuel as well as to heat, abrasion, and water. Nitrile rubber has good gas impermeability compared to Natural rubber and SBR.

It has a good resistance to ageing and undergoes little fatigue under dynamic stress.

Applications:- NBR is used in structural adhesives, auto transmission seals, water pump seals, milking inflections, fuel lines and hose, flexible couplings etc.

4. CHLOROPRENE RUBBER (CR):- Popularly known as Neoprene Rubber

Tensile Strength: - Tensile Strength slightly lower than natural rubber but better than Nitrile rubber.

Tear Strength: - High tear strength can be obtained by using a lower degree of cure.

Compression Set: - A good resistance to compression set can be obtained.

Features: - It is flame resistant and moderately good resistant to oils and considerable resistant to many chemicals.

It has excellent resistance to weather and ozone.

Optimum electric properties are obtainable.

Applications :- Strips for auto industry; seals and bellow, for machines and motor vehicles, Buffers and springs for heavy machines, Roll covers for machines, process equipment, printing, V- belt for motor vehicles etc

5. HYPALON (CSM):-

Chemically known as chlorosulphonated polyethylene.

Tensile Strength: - With the appropriate grade, a high tensile strength can be obtained.

Compression Set: - The resistance to compression set is good.

Heat Resistances: - It is serviceable up to 120°C continuously and higher temperature intermittently.

Features: - Its resistivity to low voltage is good and dielectrical strength is also very good. It has outstanding resistance to ozone attack and colour retention during light exposure. They have excellent resistance to flame, oils, heat, weather, chemicals and abrasion resistance. Hypalon also has good resistance to oxidizing chemicals at room temperature. It has resistance to water, alcohol and its resistance to mineral oil is equal to that of chloroprene rubber.

Applications :- Hypalon is used in Fleotic products, Hose for automotive industry, Automotive parts like spark plug boots, primary and ignition wires etc.

6. BUTYL RUBBER (IIR):-

It is a copolymer of isobutylene and isoprene.

Tear strength: - At room temperature, the tear resistance is slightly less than that of natural rubber, but at higher temperature is almost equal to that of natural rubber.

Heat Resistance :- - A conventional cured compound is continuously serviceable at 100°C.

Flexibility: - Butyl rubber remains flexible even at -70°C.

Features: - It has good resistance to chemicals of polar solvents and to aqueous acid, bases and oxidizing agents.

It has good resistance to animal and vegetable oils but poor resistance to mineral oils.

Butyl rubber is outstanding in its permeability to gases.

Applications :- It is used in irrigation tubing, tank linings, roof coverings, printing rolls, gloves, sporting goods, inflatable goods, weather strips, pedal pads, radiator hoses and in Medium & high voltage insulation cables / wires.

7. POLYACRYLIC RUBBER (ACM):-

Hardness: - Hardness ranges from 40 to 90 shore 'A' .

Elongation: - 100 - 400 %

Tensile Strength: - Tensile strength from 70 kg/cm² to 140 kg/cm² is obtainable.

Compression Set: - Compression set resistance at 150°C is found to be between 20 - 35%.

Features: - It has excellent resistance to heat and oils and serviceable at continuous temperature of 180°C and intermittent temperature of 200°C.

It has excellent ozone resistance, resistance to sunlight fading resistance to hot oils.

Applications :- It is mostly used in the manufacturing of rear end bearing seals, automatic transmission seals, valve stem seals , diaphragm stock, etc.

8. ETHYLENE PROPYLENE DIENE MONOMER (EPDM):-

Hardness: - Hardness ranges from 40 to 90 shore 'A' .

Tensile Strength: - Maximum tensile strength can exceed 200Kg/cm².

Compression Set: - With special compounding very good Compression Set result is obtainable.

Steam Resistances: - It has excellent resistance to steam. It remains serviceable even at high steam pressures of 250 p.s.i.

Chemical Resistance: - EPDM is resistant to most polar materials such as water, phosphate esters, ketones, alcohols and glycols. They are used in contact with various acids, alkalies and vegetable oils.

Features: - It has excellent resistance to deterioration by ozone, Oxygen, weather, heat & chemicals. It can stand a continuous temperature upto 140°C and remain flexible till -50°C.

Applications: - EPDM extensively used in the automotive industry as door seals bushings, gaskets, radiator hose, brake seals , body mounts etc.

9. SILICON RUBBER (VMQ)

Heat Resistance: - It is permanently resistant to hot air at temperature upto 180°C and even at 250°C they remain elastic after several thousand hours.

Flexibility: - It remains flexible at temperature down to -100°C.

Compression Set: - Appropriately cured silicon has extra ordinary low compression set.

Features: - Silicon Rubber has excellent resistance to hot air and at the same time remains flexible at extremely low temperatures.

The silicone vulcanisates withstands acids, ozone and weathering including the action of sunlight at high altitudes and ultra violet light.

It has good resistance to boiling water

It has outstanding physiological properties which is better than that obtainable with any other elastomer available.

Applications: - It is used in aerospace industry in the form of O-Rings, Seals and Gaskets, in gas turbines engines, piston and jet engines. Washer for electric capacitors, diaphragms for electric contractors etc.

10. FLUOROCARBON RUBBER (FKM):- commonly known as **VITON®**

Hardness: - 60 to 95 shore 'A'

Compression Set:- Best Compression Set resistance is obtained if vulcanisates are oven post-cured.

Oil, Chemicals and Solvent Resistance: - Viton is highly resistance to most oils chemicals and solvents.

Features: - The continuous services limits for Viton® are over 3000 hrs @ 230°C, 1000 hours @ 260°C and 240 hours @ 285°C and so on.

They are ozone proof but it is difficult to imagine the conditions which would be necessary for ozone to crack Viton.

Applications: - O - Ring seals for high temperature

Performance in aircraft lubricants and hydraulic fluids. Flat gaskets, Packings, other seals for heat and chemicals resistance. Also used on gasoline pumps, vacuum drier transformer, rotameter, speedometer cable seals, oil well components etc.

11. XNBR (CARBOXYLATED NITRILE RUBBER):-

XNBR are terpolymers of acrylonitrile, butadiene, and an acidic organic monomer grade of XNBR vary from one another in A C N content and concentration of carboxyl groups.

Features: - XNBR has the same heat, oil and fuel resistance as regular Nitrile rubber but provides superior abrasion resistance and excellent mechanical properties even at temperature around 110°C. The Main advantage of XNBR is, it is comparable to polyurethane in many applications at much lower cost.

USES :- It is used in fuel resistance application where excellent abrasion resistance, tensile strength, tear strength, high modulus is required. Products like belting, footwear hoses, Industrial wheels "O" rings, Packings, Pump impellers, textile etc.

12. HNBR (HYDROGENATED NITRILE RUBBER):-

Heat resistance: - The workable temperature for HNBR varies from 150°C to 175°C depending on the percentage of un-saturation and this makes it suitable for application against oxidation ozone and other weathering conditions.

Low temperature properties:-

It has very good low temperature properties in terms of both brittle point and stiffness.

Compression set :- The compression set resistance at elevated temperature around 160°C is excellent and is second to silicone rubber (VMQ type)

Fluid Resistance: - HNBR compounds show very little loss in physical properties in different fluids, as swell in oils such as engine oil, transmission Oil, hypoid gear oil etc.

Features: - HNBR elastomers are made of by the selective hydrogenation of Nitrile rubbers in the presence of sophisticated catalyst systems.

It also known as highly saturated Nitrile (HSN). It used at high temperature between 150°C to 175°C. It has excellent resistance to aggressive fluids and resistance to many chemicals. Besides this HNBR has other properties like steam resistance, ozone and weathering and also excellent resistance to radiation.

Application :- It used in Nuclear plant, Oil and Gas Industry, Military and Aerospace like in Rocket bladder, Navy cable etc., Also used in textile and Automotive applications, fuel line, Hoses, engine oil cooler power steering, transmission Oil cooler, air conditioning etc.,

POLYURETHANE (AU/EU):-

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Properties :- Polyurethane has excellent resistance to weather by conditions like Ozone, Oxidation, Ultra - violet radiation. It has excellent resistance to gas such as propane, ethylene and valued gas.

Features: - These are high molecular weight organic materials having long numbers of urethane (NH-C-OO) groups. It has excellent abrasion resistance, Oil and fuel resistance and has excellent physical properties.

Uses: - Uses in application like seals for door locks, bumpers components, footwear industry, O-rings Packings, roll cover wheels etc...

14. **POLYBUTADIENE (PBR):-**

Polybutadiene can be prepared in either a solution or emulsion polymerization system.

Feature: - Polybutadiene is superior to natural rubber because of its high abrasion resistance, excellent heat resistance, excellent low temperature properties good resistance to light crazing, high resilience etc.

Uses: - It mainly uses in Tyre tread and side walls. Also used in shoe soles and shoe products.

15. **PVC BLENDED – NBR:-**

This is non staining polymer prepared by blending 50 to 70 parts of NBR to 50 to 30 parts of PVC of Polyvinyl chloride.

Properties: - PVC-NBR has excellent resistance to Oil. Gasoline, Ozone and weathering, as well as abrasion resistance. It replaces NBR in applications where improved weathering resistance is required and also where low compression set is not necessary as compression set of PVC - NBR is quite high when compared to NBR alone.

Features: - It has good process ability for extrusion providing excellent smooth and glossy finish to the end product giving it a plastic like appearances.

USES: - It is used in compared where high hardness compounds are required without addition of extra fillers (Black or mineral). Some of the applications are in manufacturing hoses for propane gas, parts for automobiles, rubber windows frames, Gaskets, Oil resistance shoe soles etc...

Physical/Chemical Properties of Natural and Synthetic Rubbers

| Properties | N.R | SBR | EPDM | NBR | CR | HYPLON CSM | SILICONE VMQ | VITON FKM | HNBR HSN | FLOURO SILICONE FVMQ |
|-----------------------|--------|--------|--------|--------|--------|---------------|------------------|--------------|-------------|----------------------------|
| Physical Strength | E | G | G | G | G | G | F | G | G | F |
| Compression Set | G | G | G | G | F to G | G | G | G | G | V.G |
| Tear & Abrasion | E | G | G | G | G | G | P | V.G | V.G | P |
| Resilience | E | G | V.G | G | V.G | P | G | F | F | G |
| Gas Permeability | P | P | P | P | P | P | P | P | G | F |
| Electrical Strength | E | E | G | P | G | F | E | G | P | G |
| Flame Resistance | P | P | P | P | E | P | G | E | P | V.G |
| Water Resistance | V.G | G | E | F | G | G | G | G | V.G | V.G |
| Oxidation | F | F | E | G | V.G | E | E | E | E | E |
| Ozone Weathering | P | P | E | F | V.G | E | V.G | F | E | E |
| OIL RESISTANCE | | | | | | | | | | |
| ASTM oil No 1 @ 20°C | P | P | F | G | E | G | E | E | E | G |
| ASTM Oil NO 1 @ 100°C | P | P | P | G | G | G | G | E | E | G |
| ASTM Oil No 3 @ 20°C | P | P | P | G | G | G | G | E | F | G |
| ASTM Oil No 3 @ 100°C | P | P | P | G | F | G | F | E | F | G |
| ASTM Fuel B 40°C | P | P | P | F | P | F | P | E | -- | G |
| TEMPERATURE | | | | | | | | | | |
| Max Ext Temp°C | 90°C | 105°C | 150°C | 130°C | 125°C | 160°C | 300°C | 250°C | 180°C | 280°C |
| Max Cont Temp°C | 75°C | 85°C | 130°C | 100°C | 95°C | 130°C | 205°C | 205°C | 150°C | 200°C |
| Lowest Temp °C | - 60°C | - 55°C | - 50°C | - 20°C | - 35°C | - 25°C | - 60°C to - 80°C | - 20°C | - 28°C | - 60°C |

E = Excellent

V.G = Very Good

G = Good

F = Fair

P= Poor

