Polymer Process Engineering
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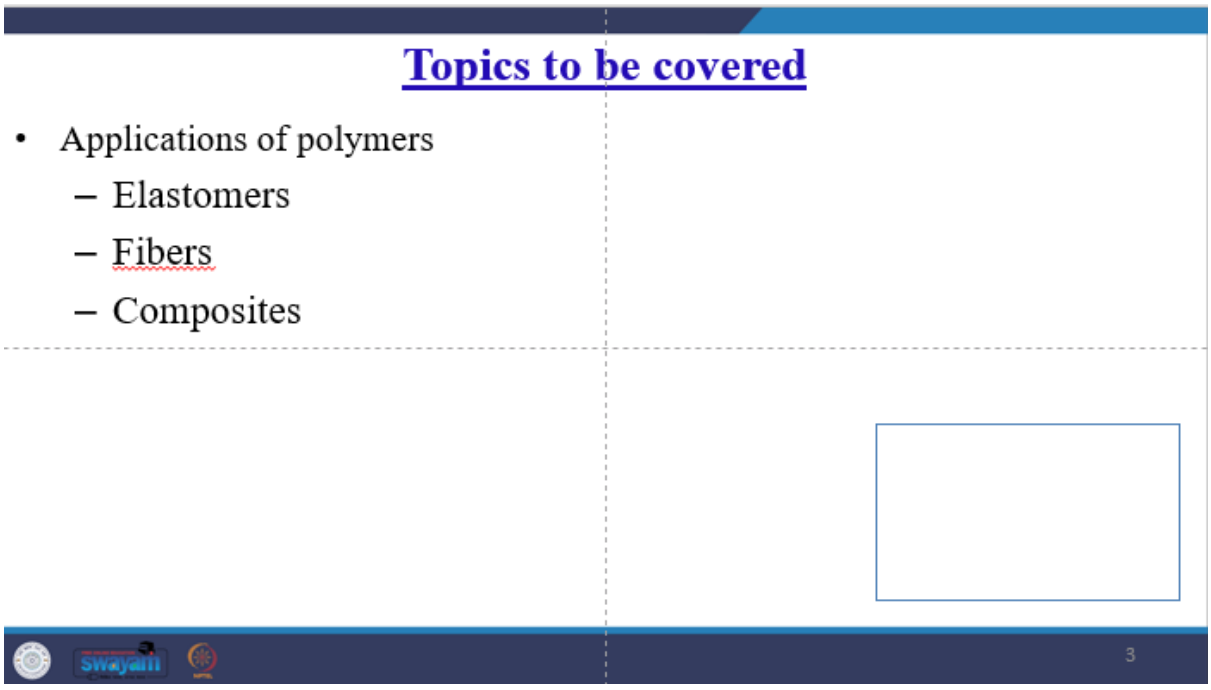
Lecture – 05
APPLICATION OF POLYMERS

Welcome to the segment of application of polymer under the edges of polymer process engineering. Now, before we go into the detail of this particular segment, let us have a brief look about that what the topics we have discussed in the previous lecture. We discussed about the branching, the cross linking, flexibility, then in detail we discussed about the crystalline amorphous behaviour of different polymers in which we discussed about the crystallinity amorphous aspect of the polymers. Then we discussed about the thermal transitions, in which we discussed about the Tg and Tm. In this particular chapter, we are going to discuss the application of the polymers under the headings of elastomers, fibres and composites. Now, let us take an example of polyethylene.



It is in its form the polyethylene is used as packaging, vibration damping, and insulation and polyethylene particularly in HDP is often used in the piping system due to its inertness, strength and ease of assembly and it is very common in household. You will see that the polyethylene pipes, HDP pipes are used in our domestic affairs. It is also used in the preparation of different types of bags, cling wraps, then they are used to make the car covers and other things. It is also used in the squeeze bottles because of the flexible character.

APPLICATIONS OF POLYMERS

- **Polyethylene**
- In its foam form, polyethylene is used in packaging, vibration damping and insulation.
- Polyethylene, particularly HDPE is often used in pressure pipe systems due to its inertness, strength and ease of assembly.
- It is used in the preparation of sandwich bags.
- It is used in the manufacturing of cling wrap.
- Polyethylene is used to made car covers.

They also used in the manufacturing of a liners of the tanks and a pond because of their inert character. It is also used in the production of the water pipes in your household applications. It is also used for the wires and the cable insulation because of the inertness and because of that range and also used in the construction in the moisture barriers. So, the intrinsic property of this HDP or the polyethylene is that they are practically inert, flexible. So, all these kinds of things being used in the various application.

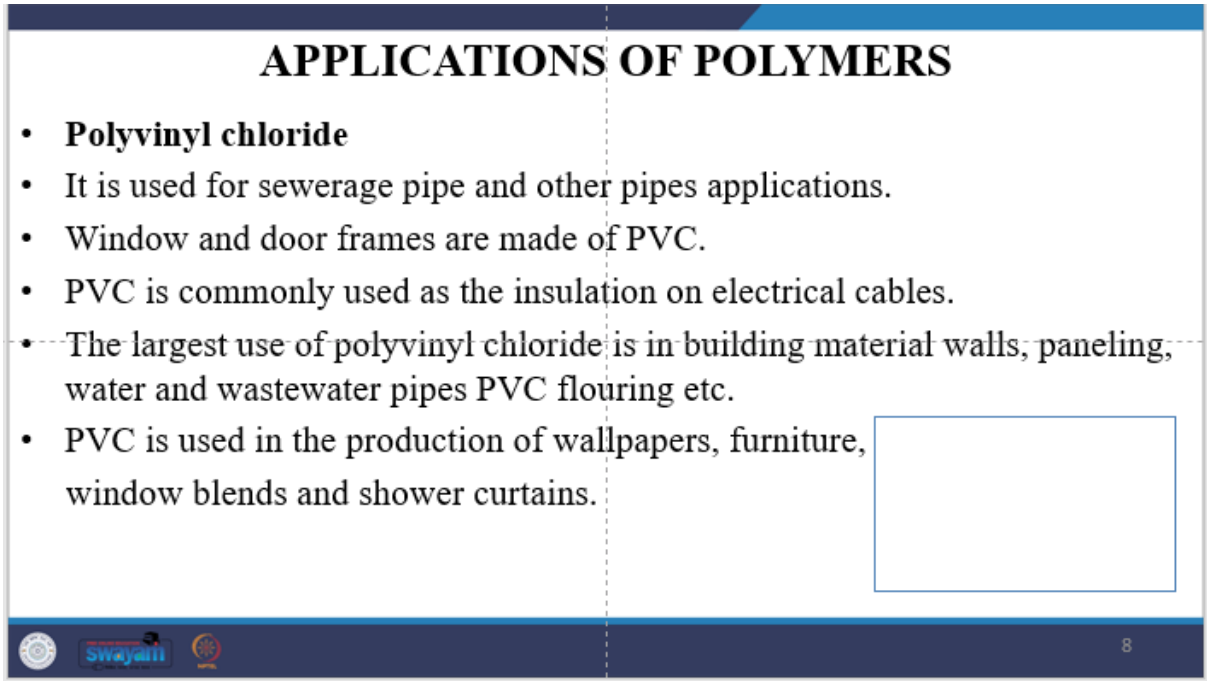
Let us talk about the polypropylene. So many plastic sand bags, resealable food storage bags, it is very common, you will find that these are the resealable bags, candy packaging. This consists of polypropylene. It is used in the manufacturing of the plastic chairs, screw and bottle caps, crates, boxes, appliances casing and toys. The manufacturers they make the polypropylene tubing that food the beverage produces used to transfer the heated liquid at a very low pressure.

APPLICATIONS OF POLYMERS

- **Poly propylene**
- Many plastic sandbags, resalable food storage bags and candy packages consist of polypropylene.
- It is used in the manufacturing of plastic chairs, screw-on bottle caps, crates, boxes, appliance casings and toys.
- Manufacturers make polypropylene tubing that food and beverage produces use to transfer heated liquids at low pressure.
- Long and short bundled strands of polypropylene appear as carpets, clothing and acoustic insulation fibers.

Long and short bundle strands of polypropylene appear as a carpet, clothing, acoustic installations and fibers. So, you see the wide spectrum of a user. Some of the composite insulating material contains a layer of polypropylene material. Insurgents in the medical application they use this trial polypropylene mesh when repairing the hernias, sutures, stitches, it also consists of the polypropylene fibers. Thermoformed polypropylene they have recently become a material of choice for inside door panels on cars.

Automakers they also installed the polypropylene tubes in areas where they require tough heat resisting and a semi flexible hoses. So, polypropylene is also used in the disposable diapers. PVC a most commonly term and abbreviated form of polyvinyl chloride. It is also used for the sewage piping, other pipe applications, windows and door frames. They are made of PVC, UPVC etc.



They are more common term nowadays. PVC is commonly used as insulation on electrical cables. The largest use of PVC is in the building material walls, paneling, water, waste water pipes, PVC flooring etc. It is used in the production of wallpaper, furniture, sometimes window blends, shower curtains all these are the major application of the PVC. This is used for the many consumer articles like in the credit cards you will see these are made of the PVC.

Imitation leather garden furnishes twice also used for the food packaging such as plastic trays. Also make candy wrap bar wrappers, boxed cookies or chocolate. PVC is also commonly used in the teethers, beach balls, bath toys, dolls, nap stacks, raincoats, and umbrellas all these are. PET most commonly used polymer. Do not forget that these are so many bottles, soft drink bottles they are the they are made of the PET polyethylene terephthalate.

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- **Polyethylene terphthalate**
- It is an excellent barrier, used to produce plastic bottles for soft drinks.
- PET is used for flexible food packaging and thermal insulation such as "space blankets".
- Because of its high mechanical strength, PET film is often used in tape applications, such as the carrier for magnetic tape or backing for pressure sensing.

It is an excellent barrier. This is PET is used for the flexible food packaging, thermal insulation such as space blankets etc. Because of the high mechanical strength, the PET film is often used in the tape application. The carrier for the magnetic tape or a backing of the pressure sensing all these things they are the best candidate for the use of the PET. Non-oriented PET sheets this can be thermoformed to make the packaging trays, blisters.

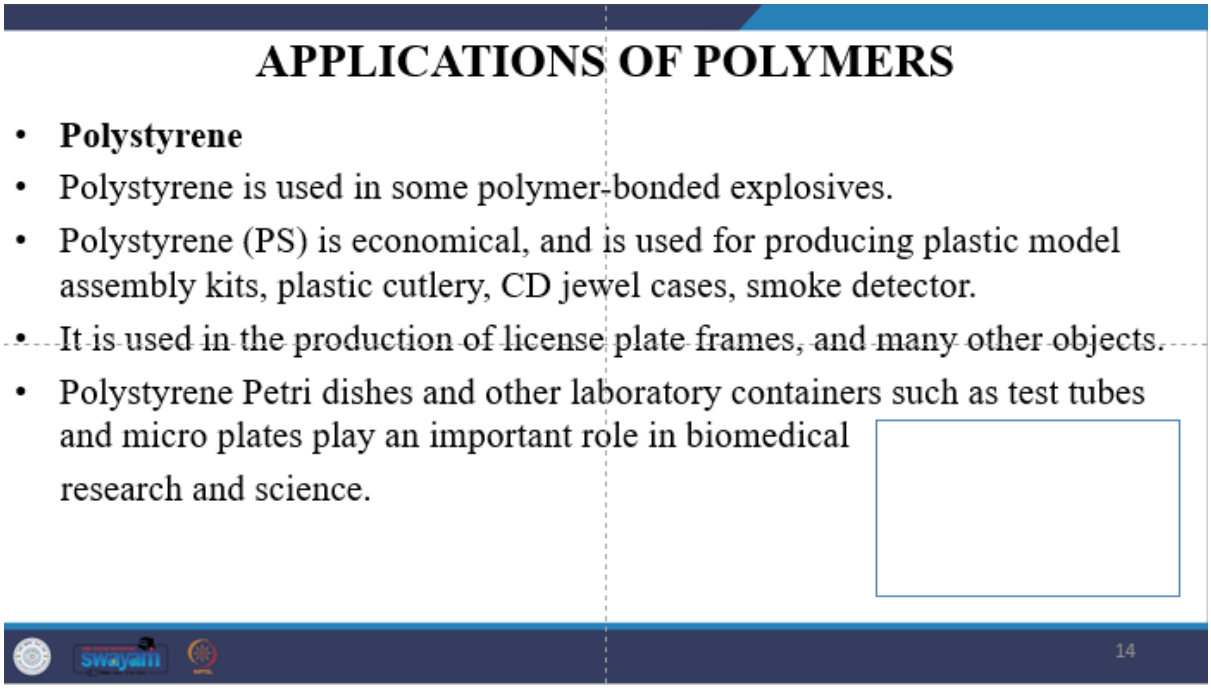
Now if they are crystallizable then trays can be used for the frozen dinner. This also used as a substrate in thin film or a solar cell also used in the production of the toys, boxes, water tanks etc. Poly imide this is used in the electronic industries for flexible cables used as an insulating film magnet wires for the medical tubing. The semiconductor industry uses the polyimide as high-temperature adhesive. It is also used as a mechanical stress buffer and some polyamide can be used like a photoresist.

APPLICATIONS OF POLYMERS

- **Poly imide**
- It used in the electronics industry for flexible cables.
- It is used as an insulating film magnet wire and for medical tubing.
- The semiconductor industry uses polyimide as a high-temperature adhesive.
- It is also used as a mechanical stress buffer.
- Some polyimide can be used like a photo resist.

So, the barriers play a vital role. The additional uses of polyimide resin is an insulating and passivation layer in the manufacture of a digital semiconductors, MEMS like microelectromechanical systems. Polyimide powder this can be used to produce the parts and shapes by sintering technologies. It is also used in the bushing, bearing, sockets, constructive parts in demanding applications. Now polyimide fibers they are used in hot gas filtration.

This film in the form of captain can be used as the diaphragm in loudspeaker tweeters. Polystyrene, most common use and it is a very, it is having the very large industrial application. It is used in some polymer bonded explosive. Polystyrene is economical and used for producing plastic model assembly kits, plastic cutlery, CD, jewels cases, smoke detectors etc. It is also used in the production of license plate frames and many other objects.



The polystyrene petri dishes and other laboratory containers like test tubes, micro plates play an important role in biomedical application. These foams, polystyrene foams are good thermal insulators and are therefore used for building insulation insulation materials. Oriented polystyrene material is also used in crafts and model building in particular architectural models. Pure polystyrene is brittle but hard enough that a fairly high-performance product is can be made by giving it some of the properties of a stretch of material such as polybutadiene rubber. Oriented polystyrene is often used in the packaging.

APPLICATIONS OF POLYMERS

- Polystyrene foams are good thermal insulators and are therefore often used as building insulation materials.
- Extruded polystyrene material is also used in crafts and model building, in particular architectural models.
- Pure polystyrene is brittle, but hard enough that a fairly high-performance product can be made by giving it some of the properties of a stretcher material, such as polybutadiene rubber.
- Oriented polystyrene is often used in packaging.
- Polystyrene foams often used for non-weight-bearing architectural structures (such as ornamental pillars).

Polystyrene foams often used as a non-weight bearing architectural structure. Cross-link polystyrene is used for the various kind of catalyst support, various kind of reactions can be performed on these types of cross-link polystyrene. Polycarbonate, this is being good electrical insulator and having heat resistance and flame-retardant properties. It is used in various product associated with the electrical and telecommunication hardware. It also serves as a dielectric in high stability capacitor.

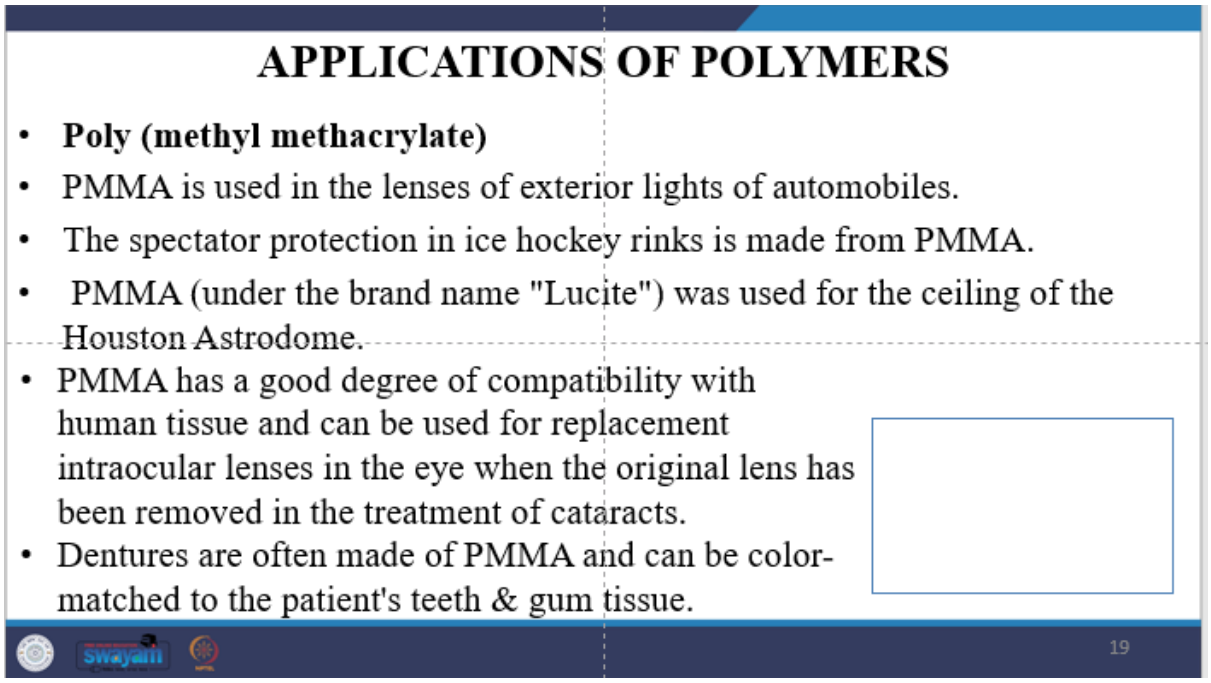
The second largest consumer of polycarbonate is the construction industry. That is for the dome lights, flat or curved glazing and a sound wall. A major application of polycarbonate is the production of a compact disc, DVDs, Blu-ray disc etc. The injection molded polycarbonate, this can produce a very smooth surface that might get well suited for a direct metalized part such as decorative vessels, optical reflectors etc. It can be laminated to make the bulletproof glasses.

APPLICATIONS OF POLYMERS

- **Polycarbonate**
- Being a good electrical insulator and having heat resistant and flame retardant properties, it is used in various products associated with electrical and telecommunications hardware.
- It also serves as dielectric in high stability capacitors.
- The second largest consumer of polycarbonates is the construction industry, e.g. for dome lights, flat or curved glazing, and sound walls.
- A major application of polycarbonate is the production of Compact Discs, DVDs, and Blu-ray Discs.

The thicker barrier or a transparent plastic used in tailor windows, barriers in banks also made of polycarbonate. So, called the theft proof large plastic packaging for smaller items which cannot be opened by hand is uniformly made by the polycarbonates. The cockpit canopy, this is the cockpit canopy of different jet fighters is made from the high optical quality of polycarbonate. The polycarbonate is commonly used as an eye protector as like this specs they are made of the polycarbonate as well as the other projectile resistance viewing the lighter application. PMMA like polymethyl methacrylate, this is used in the lenses of exterior lights of automobile.

The spectator protection in the ice hockey rings also made of a PMMA. This is PMMA was used for the ceiling in the Houston Astrodome. PMMA has a good degree of compatibility with the human tissues and can be used for the replacement of intraocular lenses in the eyes when the original lens has been removed in the treatment of cataracts. The dentures are often made of PMMA can be color matched in the patient's teeth and gum tissues. In the cosmetic surgery, the tiny the PMMA microscope suspended in some of the biological fluid they are injected under the skin to reduce the wrinkles and scars permanently.



A sizable majority of the dental filling materials are composed of PMMA. This can be used as a laser disc optical media. It is also used as a light guide for the backlights in the TFT LCD. Methamethacrylate is a purified form is used in the matrix in the laser dye-doped solid-state gain media for solid state dye. Polyurethane, it is used in garment and it is used in the garment industries during day by day.

Polyurethane is also used in molding which includes the door frames, column, molesters, window headers, pediments, medallions and rogers. Most of the cell phone covers like this, they are made of a polyurethane. This polyurethane foam is widely used in resiliency flexible foam seating rigid foam insulation panels and microcellular foam seals. The wall and ceiling not just on the futuristic but Xanadu house were built of the polyurethane foam here. Dome ceiling and other odd shape they are usually made of polyurethane.

APPLICATIONS OF POLYMERS

- **Polyurethane**
- Its use in garments is growing: for example, in lining the cups of brassieres.
- Polyurethane is also used for moldings which include door frames, columns, balusters, window headers, pediments, medallions and rosettes.
- Most of the cell phones' smart covers is made of polyurethane.

PU foam is also used in the thermal insulator in many houses and polyurethane resin is used in as an aesthetic flooring material. Foam, this was first used to build oddly shaped buildings, statues, decorations, etc. Being seamless and water resistant it is gaining interest for the use of modern interiors. Polytetrafluoroethylene, PTFE, owing to low friction it is used in the application where sliding action of part is needed or flow behaviour is needed. The powdered PTFE is used in the pyrotechnic composition as oxidizers together with powdered metals such as aluminium, magnesium, etc.

In optical radiometry sheets made from PTFE they are used as a measuring heads in spectro radio meters and a broadband radio meter. The PTFE tubes they are used in the gas-gas heat exchangers in chemical engineering and a grass cleaning waste incinerator. PTFE is also widely used as a thread seal tape in plumbing application. So those white colour tapes they are called the PTFE tapes. The PTFE membrane filters are among the most efficient used industrial air filtration application.

APPLICATIONS OF POLYMERS

- **Polytetrafluoroethylene**
- Owing to its low friction, it is used for applications where sliding action of parts is needed: plain bearings, gears, slide plates, etc.
- Powdered PTFE is used in pyrotechnic compositions as oxidizers together with powdered metals such as aluminum and magnesium.
- In optical radiometry, sheets made from PTFE are used as measuring heads in spectroradiometers and broadband radiometers (e.g., luminance meters and UV radiometers).
- PTFE tubes are used in gas-gas heat exchangers in gas cleaning of waste incinerators.

This can also be used to prevent the insects climbing up of the surface painted with the material and also sometimes used as a feat of computer mice to reduce the friction and mouse pad other tracking surfaces. Sometimes roof of lawn, building, parks, nursery, etc. are made of PTFE. Another thing is the PTFE grafts can be used to bypass the stenotic arteries in the peripheral vascular disease if suitable antilogous vein graft is not available.

Let us talk about the elastomers. One of the elastomers is polyisoprene rubber. It is primarily used in the production of tires. Polyisoprene rubber used in the manufacturing of shock absorbers, they are also used to make the gaskets. It is widely used in the production of adhesive and the formation of coating and health items. The polyisoprene is used in the production of sporting goods, different type of surfaces.

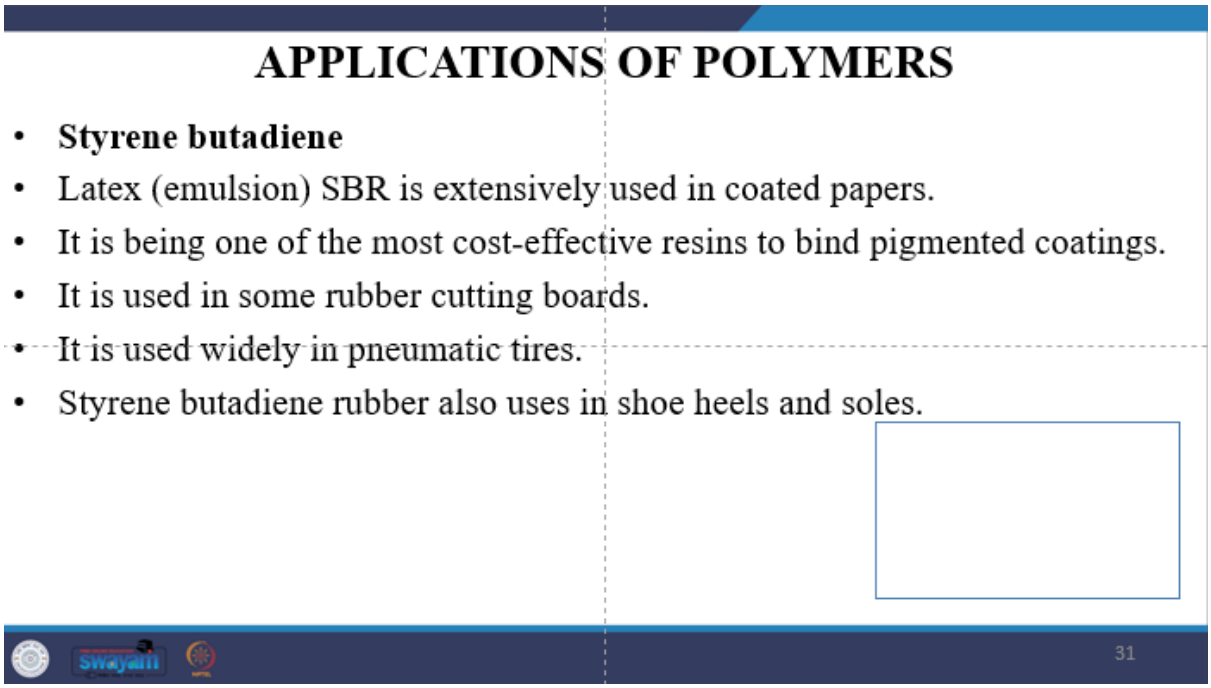
APPLICATIONS OF POLYMERS

Polyisoprene rubber

- It is used in the production of tyers.
- Polyisoprene rubber used in the manufacturing of shock absorbers.
- Polyisoprene rubber is used to made gaskets.
- It is used in the production of adhesives.
- It is used in the formation of coatings and health items.
- Polyisoprene is used in the production of sporting goods.

It is also used in the automotive mounts, gloves, the medical household and industrial. The toy balloons, they are also made of polyisoprene rubber. The polyisoprene rubber is also commonly used to make the rubber bands, very common thing, and the pencil erasers. Many aircraft tires and inner tubes are also made of polyisoprene rubbers. Styrene butadiene referred as SBR, styrene butadiene rubber.

The latex emulsion SBR is extensively used in coated papers. It is being one of the most cost-effective resin to bind pigment coating. It is used in some rubber cutting boards and also widely used in the pneumatic tires. Styrene butadiene rubber also used in shoe heels and soles. The gaskets are made of SBR also having the application in the chewing gum.



It is also used in the building applications like a sealing or a binding agent. This can be used to the tank damp rooms and also found in the toys, different type of the sponges and the floor tiles. Centroprene, the material is used for the blades on the training knives, sword and bayonets. Knife handles they are made of centroprene and commonly used in the gasket, also used in the making different appliances. Some business machines they are made of centroprene rubber and widely used in different medical devices.

Sporting goods sometimes made of Santoprene rubbers and also good option for building and construction also used in the fluid delivery system and hardware applications. Neoprene usually used in the various industrial gaskets, hoses, corrosion resistant coatings. It is also being used for the wide variety of the adhesives, especially the base of adhesives and neoprene is commonly used as a material for fly fishing ward, waders as it provides the excellent insulation against cold. Thick wetsuits commonly made of the extreme end of their cold-water protection, they are usually made of neoprene. Home accessories including laptop sleeves, iPod holders, remote controls, cycling, etc.

APPLICATIONS OF POLYMERS

Santoprene

- The material is used for the blades on training knives, swords, and bayonets.
- Knife handles are made of santoprene.
- It is commonly used in gaskets.
- It is also used for making appliances.
- Some business machines are made of santoprene rubber.
- It is used in medical devices.

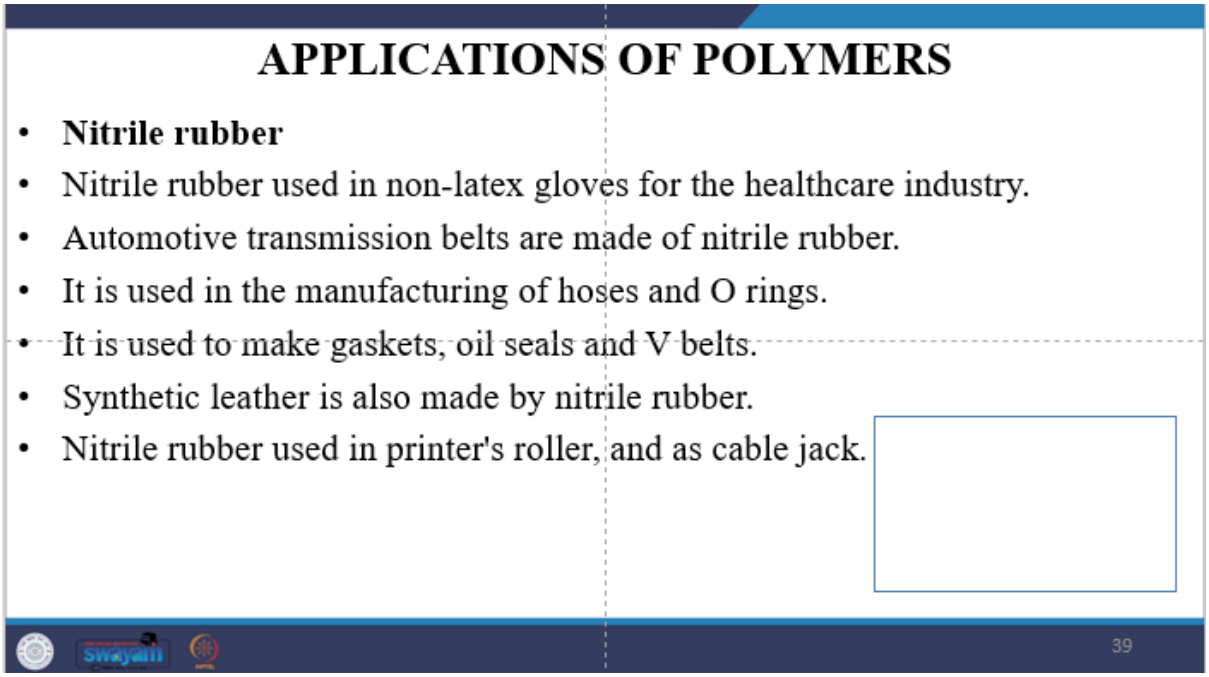
they are made of neoprene also used in the kitchens, saddle pads, bare back pads, etc. Hair soft as a protective garment, some sort of trainings, knives and swords are made of neoprene. They are also used in the drum practice pads in the music industry. Polyether block amides, the PEBA, this is referred as sometimes PEBA. This is used on medical products such as catheter for its flexibility.

It is also widely used in the manufacturing of electric and electrical goods or electronic goods like cable, wire coating, electronic device, casing, components. Now this polyether block amide can be used to make the textile films, breathable films also made of this PEBA. Fresh feeling fibres or non-woven fabrics, they are also made of this PEBA. Some hydrophilic grades of PEBA also used for the anti-static and anti-dust properties also used in various other sports application and record, etc. PEBA is found in the sport equipment market prominently.

APPLICATIONS OF POLYMERS

- **Polyether block amide**
- PEBA is used in medical products such as catheters for its flexibility,
- It is also widely used in the manufacture of electric and electronic goods such as cables and wire coatings, electronic device casings, components, etc.
- PEBA can be used to make textiles film.
- Breathable film is also made of polyether block amide.
- Fresh feeling fibers or non-woven fabrics are made of polyether block amide.

It also replaces the common elastomers like thermoplastic polyurethanes and polyesters. This is for potential use in gasoline and other organic vapor emission control separation of VOCs from nitrogen using PEBA. Nitrile rubber, these are used in non-lattice gloves for healthcare industries. Automotive transmission belts are also made of nitrile rubber also used in the manufacturing of hoses and o-rings, very common thing in the industrial application.

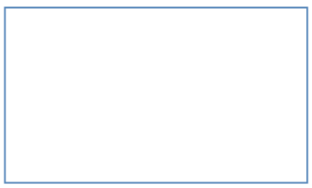


Also used to make gaskets, oil seals, V belts, etc. Synthetic leather is also made by nitrile rubber and also used as a printer's roller and cable jacks. These latexes can also be used in the preparation of adhesives, pigment binders is produced by the nitrile rubber. Hydrogenated version of nitrile rubber HNBR is commonly used to manufacture the o-rings and also used in the automotive air conditioning system. Diamine cured terpolymer rubbers, these are the low oil swell compression set combined with the good result in the gasket made with a diamine cured terpolymer rubber. Tough transmission lip seals of diamine cured polymer rubber take the pressure hot or cold.

Diamine cured terpolymer rubber is used in the production of turbo intercool hose. Molded CVJ and other boots are made of diamine cured terpolymer rubber offer heat and oil resistance and long flex life. Transmission oil coolers TOC hoses made of diamine cured polymer and perform better and hotter. It is also used in the manufacturing of the turbo ducts. Bonded piston seals made of diamine cured terpolymer rubber deliver cost effective performance.

APPLICATIONS OF POLYMERS

- **Diamine-cured terpolymer rubber**
- Low oil swell and compression set combine for good results in gaskets made with Diamine-cured terpolymer rubber.
- Tough transmission lip seals of Diamine-cured terpolymer rubber take the pressure, hot or cold.
- Diamine-cured terpolymer rubber is used in the production of turbo/intercooler hose.
- Molded CVJ and other boots are made of Diamine-cured terpolymer rubber offer heat- and oil-resistance and long flex life.

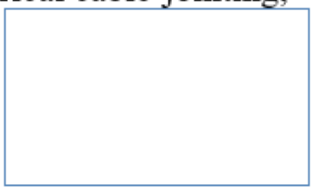


Fiber reinforced hose is also made of this and durable automotive hose made of diamine cured terpolymer rubber retain the elastomeric properties. Some of the molded parts of diamine cured terpolymer rubber help connect under the hood tubes and hoses. Hydrogenated nitrile butadiene rubber HNB are. AC seals, hoses, some of the engine seals, grommets and gaskets they are also made up of this hydrogenated nitrile butadiene rubber. Now this HNBR is used in the transmission system bonded piston seals.

So, for the industrial application it is utilized in paper mill rolls. It is also used in the rotary shaft seals. HNBR is also used in steel mill rolls. This is high performance shoes whenever this is required they are made of HNBR also used in the heat exchanger gasket and also used in the production of oil field packers.

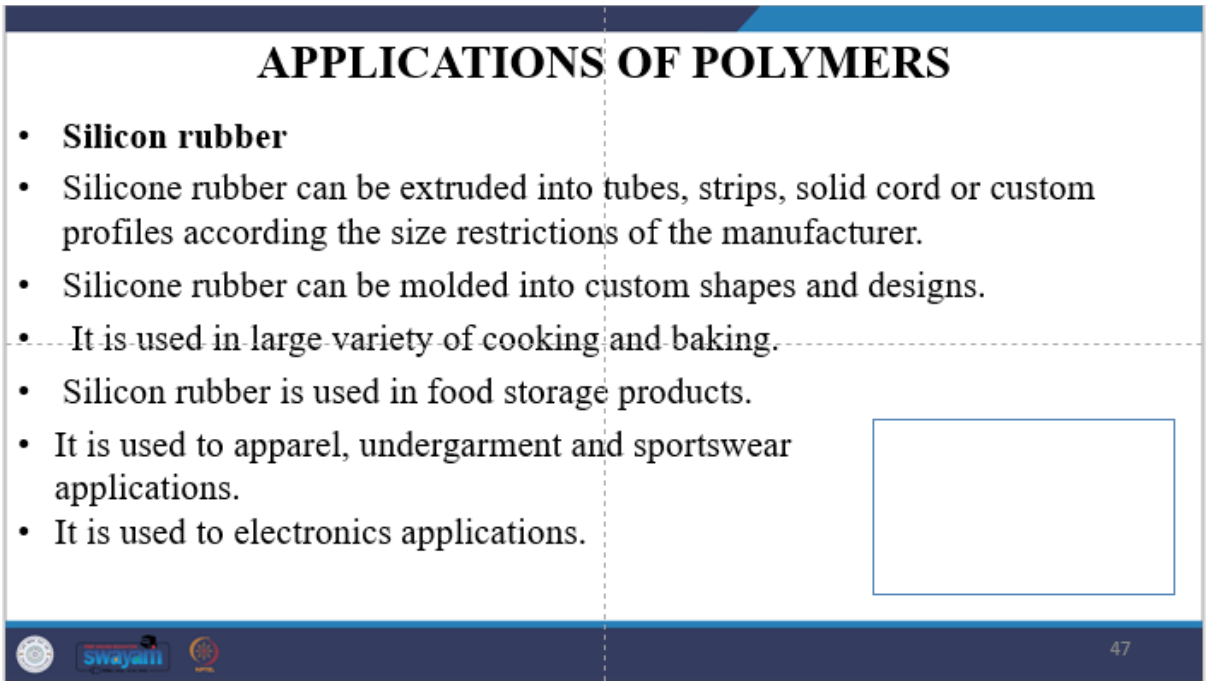
APPLICATIONS OF POLYMERS

- **Ethylene propylene dienemonomer (epdm)**
- EPDM rubber is used in seals, glass-run channels and in radiators.
- EPDM is used in garden and appliance hose.
- It is used in tubing, washers, and belts and in electrical insulation.
- EPDM is used in vibrators, and speaker cone surrounds.
- It is also used as a medium for water resistance in electrical cable-jointing, roofing membranes, geomembranes.



Ethylene propylene diene-monomers EPDM. EPDM rubber is used in seals, glass and channels, in radiators. EPDM is also used in garden and appliances, hose, etc. They are very common thing. It is also used in the tubing, washer, belt and electrical insulations. So, EPDM is also used in the vibrator, speaker cone, surrounders, etc.

also used as a medium for the water resistance in electrical cable joining the roof membranes, geomembranes, etc. EPDM is also used in the rubber mechanical goods in the plastic impact modification and in the weather seals for all vehicles. It is also used in the cooling system of the circuit houses and automobile also used in as a charge air tubing on turbocharged engine and it is used in the cold room doors for sealing purpose. Silicon rubbers. This is a very important thing and the silicon rubbers can be extruded into the tubes, strips, net cords or custom profile according to the size restriction of the manufacturer.



So, silicon rubber, this can be molded into the custom shapes and designs. It is used in the large variety of cooking and baking and the food storage products and the undergarments, sportswear application and also in the electronics application. It is also used in the home repair hardware and it is used for the destruction of the water borne bacteria. Non-dyed silicon rubber tapes with an iron oxide additive is extensively used in the aviation and aerospace wiring application and silicon rubber is also used in the formation of matrix the first automatic self-healing elastomers.

APPLICATIONS OF POLYMERS

- **Acrylic fiber**
- Some acrylic is used in clothing as a less expensive alternative to cashmere, due to the similar feeling of the materials.
- It is used in the production of socks.
- It is in the production of hats.
- It is used in gloves.
- It is used in scarves and sweaters.
- It is used in home furnishing fabrics, and awnings.

Let us talk about the fibers, acrylic fibers. Some acrylic is used in the clothing as less expensive alternative to the cashmere due to the similar feeling of materials. It is used in the production of the socks, hats, gloves, scarves and sweaters, home furnishing fabrics. It can be useful in certain items like garments for babies which require the constant washing because it is machine washable and use includes hand knitting yarns, rugs, board covers, upholstery they are also made of the acrylic fibers. Acrylic fiber is also used as the precursor of the carbon fiber. Kevlar, Kevlar is used to manufacture the gloves, sleeves, jacket and other articles of clothings.

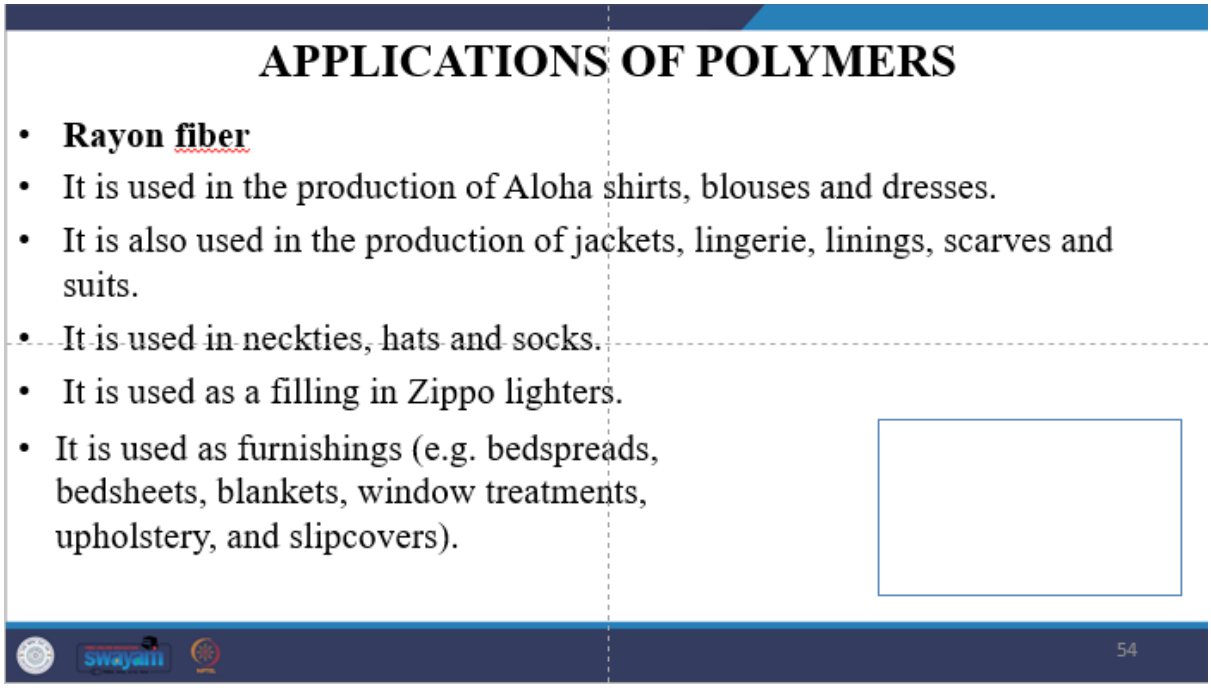
APPLICATIONS OF POLYMERS

- **Kelvar**
- Kevlar is used to manufacture gloves, sleeves, jackets, chaps and other articles of clothing.
- Designed to protect users from cuts, abrasions and heat.
- It is used as an inner lining for some bicycle tires to prevent punctures.
- Due to its excellent heat resistance, is used for fire poi wicks.
- In table tennis, plies of Kevlar are added to custom ply blades, or paddles, in order to increase bounce and reduce weight.

And to protect users from cut, abrasion and heat it is used in inner lining of some bicycle tires to prevent the punctures. They possess a very good heat resistance properties so it is used for the firepower wicks. In the table tennis, plies of the Kevlar are added to the custom ply blades and paddles

in order to increase bounce and reduce weight. It is also used in the motorcycle safety clothing, especially in the area featuring the padding like shoulders etc.

and elbows. It is also used as a speed control patch for certain soap shoes models, one of the main materials for paraglide suspension items and the Kevlar has been used as strength material for the fiber optic cables such as one used in the audio data transmission. It is also used in the sale of high-performance racing boats, rayon fibers. It is also used in the production of aloha shirts, blouse, dresses, also used in the production of the jackets, lingeries, linings, scarves, suits, neckties, hats, socks, Zippo lighters, furnishings like bedspreads, bedsheets, blankets, window treatment, slipcover, upholstery etc. Some of the industrial uses possess in the medical surgery products, rayon is also major feedstock for the production of carbon fiber.



Also used in the yarn, feminine hygiene products, diapers, towels etc. Nylon 66, most frequently it is used in the carpet fiber, clothing, apparel, used in the tires, airbags, ropes, zip ties, these all are made of the nylon 66. It is used in the manufacture of the conveyor belts, hoses, it is a longer molecular chain, denser structure, this qualifies it as a premium nylon fiber specified most often by the professional architects, designers for the use in the commercial settings like offices, airports and other places that gets a lot of wear and tear. It also possesses the excellent choice for the residential carpet applications. Olefin fibers, used for the production of sport and active wears, lining fabrics, this can be used by itself for it blend in indoor outdoor carpet, tiles, carpet backing. This can also be used as a wall covering, slipcovers, floor covering, draperies, upholstery etc.

APPLICATIONS OF POLYMERS

- **Nylon (6,6)**
- It is used as a Carpet fiber.
- Apparel is also the application of nylon(6,6)
- Nylon (6, 6) is also used in Airbags.
- It is used in Tires.
- Zip Ties are also made of nylon (6, 6).
- It is used in Ropes.

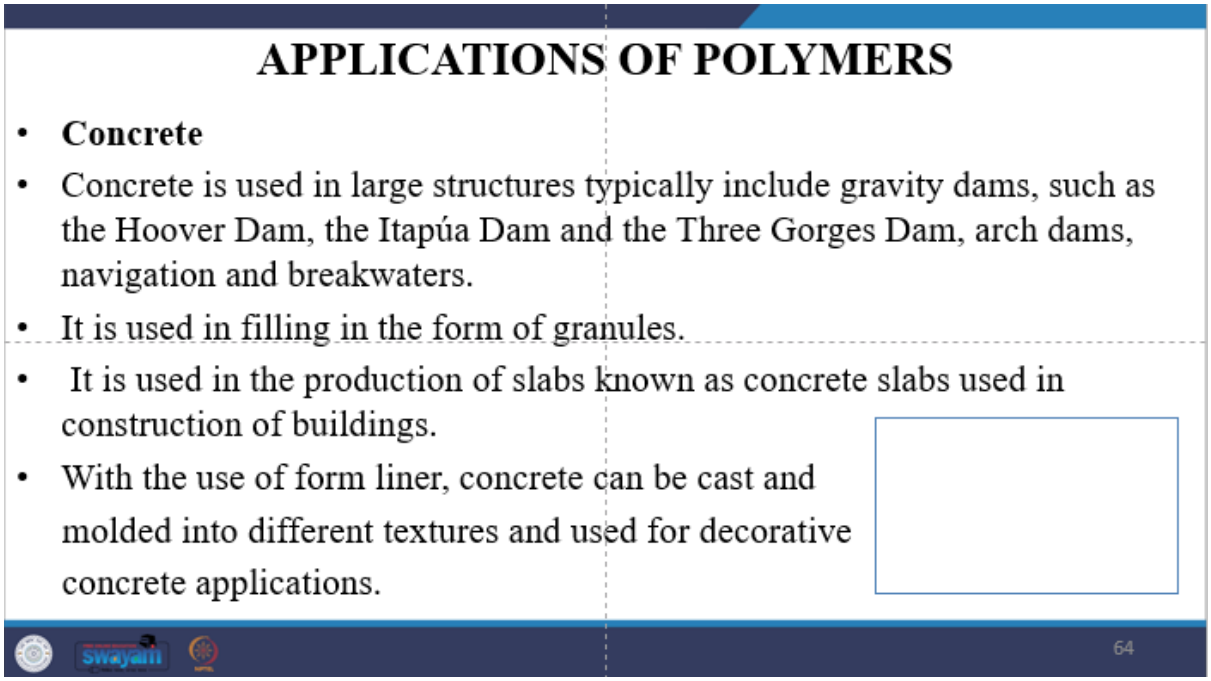
Interior fabric, sun visors, armrest, doors, sides panels, this can also be used as a trans parcel shelf, raising replacement in binders. This creates carpet, ropes, geotextiles, filter fabrics, bagging, olefin creates this concrete and its setting, industrial setting, reinforcement, heat-syllable papers, etc. Let us talk about the composites. One of the prominent composites is the fiberglass.

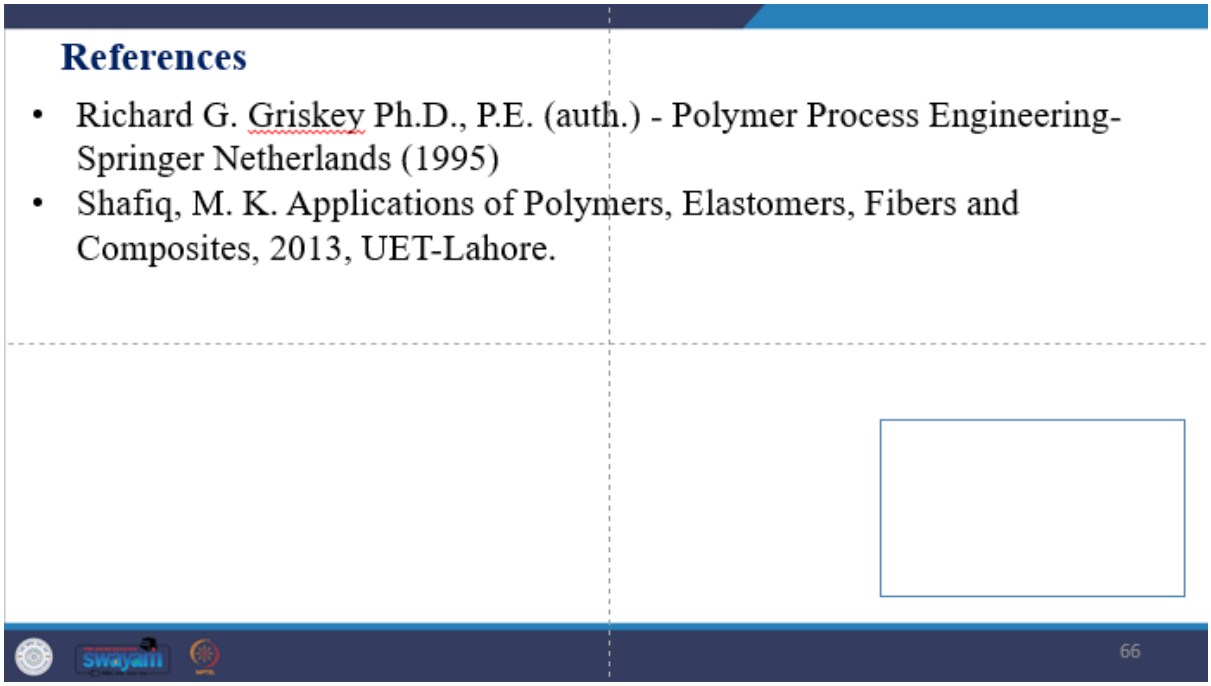
The first main civilian application was building of the boats and sports cars. It uses the automotive sports equipment sector in the aircraft. Glass fiber also uses, also included the hot tubes, pipes for the drinking water, sewers, flat roof systems, etc. Also used in the telecommunication industry, shrouding the visual appearance in antenna. Also used as the shroud of the visual appearance equipment included the sheets made from the electrical insulator, structural components commonly found in the power industries.

APPLICATIONS OF POLYMERS

- **Fiber glass**
- Its first main civilian application was for building of boats and sports car bodies.
- Its uses in the automotive and sport equipment sectors as well as in aircraft.
- Fiberglass uses also include hot tubs, pipes for drinking water and sewers, office plant display containers and flat roof systems.

Storage tanks, some storage tanks can be made of the fiberglass. Also, with the advent of high-volume manufacturing processes, it is possible to construct the fiberglass brick effect panel which can be used in the construction of the composite. GRP, glass reinforced plastic, they are also used in the house building market for the production of roofing, laminate, door sounds, over door, canopies, windows, canopies, dormers, chimneys, coping systems, etc. This is used in the production of wide variety of pipes. So, in this particular segment, we discussed a wide spectrum of polymers, especially the application part. By this way, we can see that the polymers they are entered into every aspect of our day-to-day industrial affairs.





For your convenience, we have listed couple of references. For further study, you can utilize these references. Thank you very much.