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Glass Fiber Reinforced Plastic (GRP) and Medical Application

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Abstract: Numerous common classes of polymers are composed of hydrocarbons. The polymers are especially constructed of tiny units bonded onto elongated chains. Carbon makes up the mainstay/backbone of the hydrogen atoms and the molecules. one of the most popular environmental issues linked with synthetic polymers pollution is 45% of seabird types are believed to have swallowed polymers that have been confused for food, consistent with the United States Institute of Health.

Keywords: GRP Reinforced, Application, Fiber.

I. INTRODUCTION

Glass Fiber Reinforced Plastic (GRP), similarly called Fiber Reinforced Plastic, is type of polymer matrix composites made of thermosetting resins. GRP is utilized due to its high light weight, mechanical strength, temperature and corrosion resistant properties, smooth internal surface, thermal insulation, ease of repair, flexible shapes, and its affordability. It comprises glass fiber and thermosetting resin. Its best glass fiber component and winding techniques ensure the quality and usefulness of the material (Collyer, 2014). Polymerization may be illustrated by joining strips of construction paper conjointly to build garlands or hooking together many paper clips to create chains. Polymers have remained the phenomenon material of the past century and represent the prevalent class of biomaterials. In general, polymers are substances consist of macromolecules. Macromolecule may be further defined as molecules of high comparative molecular mass, the structure that significantly composes the numerous repetitions of units derived, conceptually or actually from molecule of low relative mass.

According to Holm (2012) studies, natural polymers comprise things like tortoise shell and horns, shellac and a star, in addition tree saps that generate latex and amber. These polymers were process by applying pressure and heat into valuable articles such as jewelry and hair ornaments. Natural polymers started to be chemically altered during the 1800s to make several materials. The most popular of these included celluloid, rubber, and gun cotton. The initial synthetic polymer developed was Bakelite during 1909, and was later succeeded by the first rayon, semi-synthetic fiber, which was produced during 1911(Williams, 2013).

Even with these progresses, it was not until the Second World War that considerable transformations occurred in the polymer sector. Before the Second World War, natural elements were obtainable, thus, synthetics that were being produced were not essential. After the world resumed war, natural sources of silk, latex, wool, and other materials were depleted, making the application of synthesis crucial (Broz, 2010).

During this period, people started using acrylic, polyethylene, SBR, neoprene, nylon, and several other polymers replaced natural materials that were no longer accessible.

From that period, polymer industry has progressed to develop and has changed into one of the quickest growing industries in the United States and the rest of the world. The application of multiple polymer systems within the medical industry spans numerous uses. The extensive variety plant materials like natural rubber, cellulose, tissue-based sutures and valves, heparin, hyaluronic acid and collagen materials are examples (Abidian, 2015).

II. STRUCTURE OF POLYMERS

Numerous common classes of polymers are composed of hydrocarbons. The polymers are especially constructed of tiny units bonded onto elongated chains. Carbon makes up the mainstay/backbone of the hydrogen atoms and the molecules (Hult & Rammerstorfer, 2014). The diagram below represents a polyethylene, the simplest structure of polymer:

There are polymers that have only hydrogen and carbon (such as polystyrene, polypropylene, polymethylpentene, and polybutylene). Although the basic structure of several polymers is hydrogen and carbon, other compounds may also be included. Other compounds that are traceable in molecular structure of polymers encompass silicon, oxygen, nitrogen, chlorine, sulfur, phosphorous, and fluorine.

Polycarbonates and polyesters contain oxygen. Polyvinyl chloride (PVC) comprises chlorine. Teflon comprises fluorine. Nylon has oxygen and nitrogen. Vulcanized Thiokol and rubber contain sulfur. There are similarly particular polymers that rather than encompassing carbon backbones possesses phosphorous or silicon backbones. These are regarded inorganic polymers. The most common silicon-based polymers include Silly Putty (Williams, 2013).

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III. POLYMERIZATION AND MOLECULAR STRUCTURE

The first element that is employed to produce polymers is monomer or "mer". Monomers are chemically bonded together in one of two methods: condensation polymerization or addition polymerization (Harada, 2014). Addition polymerization is compost of 3-essential phases: initiation, propagation, and terminations. For instance, in the initiation stage of polyethylene polymerization, the double bond is in the monomers (mer) break and starts to bond together. A promoter or catalysts can be required to speed up or start the reaction. The second stage, propagation, entails the continual adding of monomers into chains. The last step is termination in which all monomers can be utilized, contributing the reaction to stop.

A polymerization reaction may stop by slaking the reaction. Equal to quenching an individual's thirst, water may be used to rapidly cool any reaction. Polymers created by addition polymerization incorporate polystyrene and polyethylene, and so forth (Holm, 2012).
Addition polymerization defines the process of monomers bonding by each one adding on the ending of the last monomer. A simple visual of the method involves paper clips joined together to create an elongated chain. Polymers developed by addition polymerization are usually thermoplastic naturally. Thermoplastics are typical to hot melt adhesive sticks that may be heated and become soft and turn hard in case they are when cooled. Thermoplastic polymers may be processed, reprocessed or recycled easily. The mainstream of polymers used currently is thermoplastics (Williams, 2013).

The last group of polymers is formed through condensation polymerization. A petite molecule is removed while monomers join together during the chemical reactions of condensation polymerization. Popular polymers found in this category include urethanes, nylons, some polyesters, and urea. These polymers may be thermoplastic naturally or thermosetting. After thermoset polymers are formed, they may not be reformed or melted. All plastics flow at some moment while they are being processed and solid in finish state, although after a thermoset is processed, it is radically dissimilar and may not be reformed (Abidian, 2015).

The mechanism of polymerization will interfere with the heat reaction of the produced polymer. Also, the pattern of the "mers" in the molecule will influence the physical properties of the formed polymer. "Mer" linked together in long chains characterizes a linear arrangement extremely identical to a paper clip chain (Collyer, 2014). Albeit in actuality, tetrahedral bonds provide the molecule a zigzag configuration. During polymerization, if the monomers or "mers" not only form long chains but also form the straight chains off the major backbone, the eventual arrangement is referred as branched, like a grape stem or a tree branch. A third configuration is attained by elongated chains being chemically joined together. An instance would be isoprene (natural rubber) reacting with sulfur. The sulfur joins the chains to create massive meshwork of molecular structure that is called vulcanized rubber. This is a cross-linked structure.

Polyethylene contains the simplest "mers" pattern. Although the backbone of some polymers will be likewise created by a broken bond between 2-carbons, the residual carbons in the monomer will create a functional group whose configuration around the mainstay will impact the physical nature of resultant polymer.

For instance, propylene is the monomer that will construct polypropylene. Polymerization is instigated by the double bond-breaking and the monomer bonding together. When methyl grouping (CH3) is aligned recurrently on a single lateral of the chain on interchanging carbons, it is known as isotactic. About 90-95% of polypropylene features this orientation (Broz, 2010).

Molecular Arrangement of GRP
Reflect on how noodles appear on a plate. This is the same to how polymers may be arranged in when they are amorphous. An amorphous arrangement/configuration of molecules does not have long-range form or order where the polymer chains configure themselves. Amorphous polymers are naturally transparent. This is a beneficial property for multiple uses like headlights, food wrap, contact lenses, and Plexiglas. Quenching and controlling the polymerization procedure can lead to amorphous orientation (Hult et al., 2014).

Apparently, not every polymer is transparent. The polymer chains in items that are opaque and translucent are in crystal-like arrangement. By description, a crystalline organization has ions, atoms, or, in this scenario molecules in distinct pattern. Crystalline structures are like gemstones and salts, but not as plastics (Harada, 2014). The greater the degree of crystallity, the less light is able to pass via the polymer. Consequently, the degree of opaqueness or translucence of polymers is directly influenced by its crystallity.

Similarly, crystallity affects the polymer's melting point. The more crystalline the arrangement of the molecules, the more energy increased energy is required to make the molecules to break, melt, and flow (Collyer, 2014). In contrast, amorphous polymers will have reduced melting points. Caution must be considered to maintain the degree of crystallity within a polymer. Recycling, reprocessing, fabrication, overheating, UV light, machining, or heat is a service employed. Storage can also possibly affect the plastic's crystallity. The strength and melting point of a polymer increases with the augmentation its crystallity (Strobl, 2011).

By controlling parameters on the molecular phase that impact the ultimate polymer made, engineers frequently are challenged to develop suitable materials for a broad diversity of new and old applications intended improve individuals' health (Broz, 2010). Processors and manufacturers introduce numerous additives, reinforcements, and reinforcements into the base polymers escalating object potentials.

IV. MECHANICAL PROPERTIES OF GRP

The two main groups of polymers include thermosets and thermoplastics. Both groups are naturally based on the heat reaction of polymers. GRP' light transmittance comprises the depiction of materials as being translucent, transparent or opaque. Transparent polymers are the once you may not see through, albeit permit light to pass through. Opaque polymers are the ones you main neither seer through nor permit light to pass through. Qualities of light penetration are reliant on the degree of polymer crystallization and the existence of additives. Each polymer has very distinctive characteristics (Holm, 2012). Numerous polymers have the subsequent attributes:

1. Polymers could be very resistant to chemicals. Take into consideration the cleaning liquids in your residence that are packed suing plastic materials (Strobl, 2011).

2. Polymers may be both electrical and thermal insulators. Materials that apply polymers insulators include freezers and refrigerators, microwave cookware, underwear worn by skiers.

3. Polymers are tremendously light in mass with different degree of strength. They include fragile nylon fiber utilized to make pantyhose employed in bulletproof vests.

4. Polymers may be processed in varied ways to develop thin fibers or very complex parts. They include paints or adhesives, and elastomers (Williams, 2013).

Advantages of GRP

- GRP are ultra-durable (does not break or corrode and is slow to degrade).
- They may be formed into nearly all shapes possible, and may be custom colored during the production phase, thus painting is unnecessary.
- GRP are also recyclable.
- Cheaper than other materials
- Good insulator of heat and electricity hence applied in medical devices, home insulation and wire covers
- GRP are less dense so lighter
- Wind power is improbable with no plastics.

Disadvantages

- Take up huge pace in landfill
- Produce poisonous gases during burning
- Cause prolusion in oceans and seas
- Use up a finite/nonrenewable resource
- Take long period to decompose

In medicine, biodegradable GRP provide high potential for regulating wound management and drug administration (such as surgical meshes, adhesives, and sutures), for dental applications (such as filter following tooth extraction), for orthopedic devices (such as rods, screws and pins), and tissues engineering (Broz, 2010).

GRP are biocompatible, does not evoke inflammatory reaction, and have appropriate mechanical and processing properties that suite them to be applied in medicine. Moreover they are not dangerous to the body and are easily excreted or reabsorbed (Holm, 2012).

Consistent with Williams (2013) findings, multiple polymers may be used outside the body for packaging drugs. Prefilled syringes and plastic ampullas are simple to employ, though the adsorption and relocation of the bioactive products into the polymer, pH variations, optical properties, oxygen permeation and the discharge of leachable composites must be taken into consideration cautiously for individual application.

Multilayer container is utilized to attained required features of inertness, UV or oxygen protection. Copolymers and cyclic olefin polymers are widely applied in operation because of their stability, inertness, mechanical and properties at steam sterilization. The tip cap and the stopper are often constructed of elastomers (Hult et al., 2014).

Polyvinyl chloride (PVC) can be transformed to flexible containers, medical tubing, check valves, heart-lungs bypass sets, hemodialysis sets. PVC comprising the phthalate plasticizer DEHPs is applied in different extracorporeal perfusion tubes to administer prescriptions, or similarly in blood leading tubes within extracorporeal oxygenation or dialysis. In addition, blood products and blood donations are characteristically stored in polymer bags. Because of the lipophilic characteristic of the plasticizer, it moves from the surface of the polymer to the membranes and lipids of the red blood cells (Hult et al., 2014).

When reacted with phthalate concerns, optional plasticizers partially are used for storing blood cells, for example, di-iso-nonyl-1,2-cyclohexanedicarboxylate or butyryl-trihexyl-citrate (Holm, 2012).

V. CONCLUSIONS

polymers are a substantial problem on land since they are frequently disposed of in landfill in which they tend to stay for several years into the future gradually secreting toxins into soil as time elapses. Not only do these polymers gradually discharge toxic chemical in the soil, but also their non-biodegradability and durability means additional landfills will be a continuous requirement as synthetic polymer application continue to grow. Further than its obvious pollution of oceans, polymers can similarly present ecological issues during the process of their manufacturing. The Environmental group movements

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have demonstrated that numerous chemical companies leaked contaminates utilized in their formation of Teflon into regional crises for numerous decades.

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