**Assignment**

**Topic:** Inorganic Polymers, Paints and Lubricants

**Subject:** Environment Chemistry

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**INORGANIC POLYMERS**

**INTRODUCTION TO INORGANIC POLYMERS:**

Modern technologies and ordinary living both depend on polymers. These are massive molecules made up of repeating monomers that are present in a wide variety of both natural and man-made materials. The chemical make-up and arrangement of the monomers, as well as how they are connected and structured, determine the properties of polymers.

Polymers' adaptability to particular applications and their extensive range of physical and chemical properties are the reasons for their flexibility. While certain polymers are stretchy and flexible, others are robust and unyielding. Others are biodegradable and environmentally friendly, while some are heat and chemical-resistant. Modern technology and research have benefited significantly from the study of polymers, or polymer science.

Several industries, including packaging, construction, healthcare, and electronics, use polymers in various ways. They have completely changed the way we live our lives and are now a crucial component of many contemporary items.

In general, organic polymers and inorganic polymers can be divided into two basic categories.

1. Organic Polymer

2. Inorganic Polymer

Inorganic Polymers:

Inorganic polymers are a class of polymers that do not contain carbon atoms in their backbone, and are composed of inorganic elements such as silicon, phosphorus, and metals. The majority of the time, chemical reactions are used to create them, and they are renowned for their high levels of chemical and thermal stability as well as their mechanical strength. There are several uses for inorganic polymers, such as in ceramics, adhesives, and coatings.

General Properties of Inorganic Polymers

1. Inorganic polymers are able to withstand high temperatures without melting or degrading.

2. Inorganic polymers are resistant to a wide range of chemicals, including acids, bases, and

solvents.

3. Inorganic polymers have a strong resistance to deformation and are stiff.

4. Inorganic polymers do not considerably expand or contract in response to variations in

humidity or temperature.

5. Water does not readily incorporate into inorganic polymers.

6. Inorganic polymers are hard and have a high resistance to wear and abrasion.

Classification of Inorganic Polymer:

Inorganic polymers can be categorized according to their structure and composition. Inorganic polymers can be divided into the following typical categories:

1. Polyphosphazines

2. Sulphur based polymer

3. Silicones

Preparation and uses of Inorganic Polymer

1. Polyphosphazines:

Polyphosphazines are a class of inorganic polymers that are composed of alternating

phosphorus and nitrogen atoms, with organic substituents attached to the nitrogen atoms.

a. Polyphosphonitrile chlorides:

They are prepared by reaction between phosphorus pentachloride and ammonium chloride in

presence of C6H5Cl at 120-150oC followed by heating cyclic tetramer in vacuum at 250oC

forming chain polymer.

b. Polydimethoxy phosphazines and polydiethoxy phosphazines:

They are prepared by the reacting of phosphonitrile chloride with sodium methoxide and

sodium ethoxide respectively.

Uses:

* They are used in plastics, coatings, and textiles.
* They are used for preparation of thermopolymers.
* They are used in adhesives.

2. Sulphur-based inorganic polymers:

a. Linear chain polymers:

1. Polymeric Sulphur (PS):

Polymeric sulfur is prepared by heating elemental sulfur above its melting point (119 °C) under high pressure in the presence of a radical initiator, such as a peroxide, to initiate the polymerization reaction. The resulting polymeric sulfur is then cooled and ground into a fine powder.

1. Polymeric sulphur nitride (SN)n:

Polymeric sulfur nitride is an inorganic polymer that is synthesized from sulfur

and nitrogen, and has semiconducting properties.

b. Chalcogenide glass or chalconide glass or network polymers:

Chalcogenide glass is a type of inorganic glass that contains one or more chalcogen

elements such as sulfur, selenium, or tellurium. Chalcogen elements like sulfur,

selenium, or tellurium are combined with metal oxides and melted under regulated

conditions to create chalcogenide glass, which is then quickly quenched to form a glass.

Uses:

* They are used in the production of rubber compounds and as a vulcanizing agent.
* They are used as an insulator in electronic components.
* They are used as a component in coatings and adhesives.
* They are used in the production of high-strength materials such as composites.
* They are used in the production of flame retardant materials.

3. Silicones or Silicone polymer:

A group of inorganic synthetic polymers with silicon atoms in its backbone are referred to

as silicones, also known as silicon polymers.

Preparation:

In order to create a polymer chain, silicon-containing compounds and organic molecules are

commonly combined to create silicones. The polymer chain is then processed by cross-linking, curing, and shaping to get the desired shape. Depending on the desired silicone qualities and the intended application, different preparation techniques may be used.

1. Monomethyl silicon trichloride- CH3SiCl3 A white liquid called monomethyl silicon trichloride is a precursor used to make various organosilicon compounds as well as silicone polymers. Three chlorine atoms, one methyl group, and one silicon atom make up this compound.
2. Dimethyl silicon dichloride (CH3)2SiCl2: Dimethyl silicon dichloride has a core silicon atom that is joined to two methyl groups, two chlorine atoms, and two other atoms.
3. Trimethyl silicon chloride (CH3)3SiCl:

A core silicon atom is joined to three methyl groups, one chlorine atom, and three other atoms to form the structure of trimethyl silicon chloride.

Different Types of silicon polymer and their uses:

a. Liquid Silicon or silicon oils:

The synthetic fluids known as silicone oils or liquid silicones have a low surface

tension, great temperature stability, and a high dielectric strength. They are transparent,

colorless, and odorless.

Uses:

1. Used as high temperature lubricants.
2. Used as a hydraulic fluid I machinery and equipment.
3. Used as a release agent in food processing and baking applications.

b. Silicon greases:

Synthetic lubricants known as silicone greases are made of silicone oil and a

thickening like silica or lithium.

Uses:

1. Used in Lubrication of electrical contacts, switches, and connectors due to them
2. high dielectric strength and water repellency
3. Used in lubrication of plastic rubber parts in medical devices, such as syringes
4. and catheters.

c. Solid silicon resins:

Solid silicone resins have high thermal stability and resistance to oxidation and

weathering.

Uses:

1. Used in the sealants and gaskets in the automotive and construction industries.
2. Used as insulators and dampers in electronics.
3. Used in kitchenware and baking molds.

Advantages and Disadvantages:

Advantages:

1. Very high heat and chemical resistance
2. Having good durability and mechanical strength
3. Excellent thermal and electrical conductivity
4. A wide variety of physical characteristics can be customized for certain purposes.
5. Non-toxic and flammable
6. Immunity against UV rays and weathering
7. The capacity to tolerate sever conditions and high temperatures

Disadvantages:

1. Often less flexible and more brittle than organic polymers
2. Often more costly to create
3. High melting points and chemical resistance might make processing and production more
4. challenging.
5. Organic polymers are more readily available and have a wider range of options than inorganic
6. polymers.
7. Usually less strong and impact-resistant than organic polymers.
8. Applications of Inorganic Polymers in the field of computer engineering:
9. In the subject of computer engineering, inorganic polymers are used in a variety of different ways.

In this area, the creation of robust and high-performance electronic components is one of the main uses of inorganic polymers. Inorganic polymers are frequently employed as insulators,

semiconductors, and conductors in microelectronic devices including transistors, capacitors, and integrated circuits because of their superior electrical conductivity and thermal stability.

In addition, inorganic polymers are used in the construction of optical fibers for networks of fast communication. These fibers are made of silica and have inorganic polymers added to them to give them extra qualities like increased mechanical strength and a higher refractive index.

Additionally, inorganic polymers can be employed to create sophisticated ceramic materials for use in applications in computer engineering. For instance, due to their great strength and hardness, silicon nitride and silicon carbide-based ceramics are frequently used for making mechanical components, such as bearings and cutting tools.

Overall, inorganic polymers have special qualities that make them useful in the field of computer engineering, where a variety of electronic and mechanical applications call for high-performance and long-lasting materials.

Impact of Inorganic polymers upon the environment:

In spite of their widespread use in many industries, inorganic polymers have the potential to

significantly harm the environment.

The following are a few effects of inorganic polymers on the environment:

1. Pollutants and greenhouse gases can be released into the atmosphere during the production of inorganic polymers.
2. As inorganic polymers cannot biodegrade; they might build up in the environment and endanger ecosystems over time.
3. Landfills and other problems with waste management may result from the disposal of inorganic polymers.
4. If inorganic polymers are not treated appropriately, they may include dangerous substances like lead or arsenic that could endanger both human health and the environment.
5. Glass and ceramics are two examples of inorganic polymers that are generally harmless and may be recycled or used again, lowering their environmental impact.
6. The manufacture of inorganic polymers may need a significant quantity of energy and water, which could result in higher water and carbon dioxide emissions.
7. Inorganic polymers may cause physical injury or even death to wildlife when they entangle or are consumed by them.
8. Certain inorganic polymers, such as specific kinds of plastics, can leak poisons into the environment as they degrade over time, causing soil and water contamination.
9. Disposing of inorganic polymers can also have a role in the development of microplastics, which can have a significant negative effect on marine ecosystems.
10. In general, the effect of inorganic polymers on the environment is complicated and varies depending on the type of polymer and how it is used. Initiatives to lessen environmental.

LUBRICANTS

***INTRODUCTION***

A lubricant is a substance introduced to reduce friction between surfaces in mutual contact, which ultimately

reduces the heat generated when the surfaces move. It may also transmit forces, transporting foreign particles, or heat or cool the surfaces. The property of reducing friction is known as lubricity. In addition to industrial applications, lubricants are used for many other purposes. Other uses include cooking (oils and fats in used in frying pans, and in baking to prevent food sticking), bio-medical applications on humans (e.g., lubricants for artificial joints), ultrasound examination, medical examinations, and the use of personal lubricant for sexual purposes.

***FUNCTION OF LUBRICANTS***

One of the single largest applications for lubricants, in the form of motor oil, is protecting the internal

combustion engines in motor vehicles and powered equipment.

1. Keep moving parts apart

Lubricants are typically used to separate moving parts in a system. This separation has the benefit of reducing friction and surface fatigue, together with reduced heat generation, operating

noise and vibrations.

2. Reduce friction

Typically, the lubricant-to-surface friction is much less than surface-to-surface friction in a system without any lubrication. Thus, the use of a lubricant reduces the overall system friction.

3. Transfer heat

Both gas and liquid lubricants can transfer heat. However, liquid lubricants are much more effective on account of their high specific heat capacity. Typically, the liquid lubricant is constantly circulated to and from a cooler part of the system, although lubricants may be used to warm as well as to cool when a regulated temperature is required.

4. Carry away contaminants and debris

Lubricant circulation systems have the benefit of carrying away internally generated debris and external contaminants that get introduced into the system to a filter where they can be removed.

5. Transmit power

Lubricants known as hydraulic fluid are used as the working fluid in hydrostatic power transmission. Hydraulic fluids comprise a large portion of all lubricants produced in the world.

The automatic transmission's torque converter is another important application for power transmission with lubricants.

6. Protect against wear

Lubricants prevent wear by keeping the moving parts apart. Lubricants may also contain anti-wear or extreme pressure additives to boost their performance against wear and fatigue.

***TYPES OF LUBRICANTS***

Synthetic oils

Petroleum-derived lubricants can also be produced using synthetic hydrocarbons (derived ultimately from petroleum).

Solid lubricants

1. PTFE: polytetrafluoroethylene (PTFE) is typically used as a coating layer on, for example, cooking utensils to provide a non-stick surface. Its usable temperature ranges up to 350 °C and chemical inertness make it a useful additive in special greases. Under extreme pressures, PTFE powder or solids is of little value as it is soft and flows away from the area of contact. Ceramic or metal or alloy lubricants must be used then.

2. Inorganic solids: Graphite, hexagonal boron nitride, molybdenum disulfide, and tungsten disulfide are examples of solid lubricants. Some retain their lubricity to very high temperatures. The use of some such materials is sometimes restricted by their poor resistance to oxidation (e.g., molybdenum disulfide degrades above 350 °C in air, but 1100 °C in reducing environments.

3. Metal/alloy: Metal alloys, composites, and pure metals can be used as grease additives or the

Sole constituents of sliding surfaces and bearings. Cadmium and Gold are used for plating surfaces which gives them good corrosion resistance and sliding properties, Lead, Tin, Zinc alloys, and various bronze alloys are used as sliding bearings, or their powder can be used to lubricate sliding surfaces alone.

Aqueous lubricants

Aqueous lubricant is of interest in several technological applications. Strongly hydrated brush polymers such as PEG can serve as lubricants at liquid-solid interfaces. By continuous rapid exchange of bound water with other free water molecules, these polymer films keep the surfaces separated while maintaining a high ﬂuidity at the brush–brush interface at high.

compressions, thus leading to a very low coefﬁcient of friction.

Bio-lubricants

They are derived from vegetable oils and other renewable sources. They usually are triglyceride esters (fats obtained from plants and animals. For lubricant base oil use vegetable-derived materials are preferred. Common ones include high oleic canola oil, castor oil, palm oil, sunflower seed oil, rapeseed oil from vegetables, and tall oil from tree sources. Many vegetable oils are often hydrolyzed to yield the acids which are subsequently combined selectively to form specialist synthetic esters. Other naturally derived lubricants include lanolin (wool grease, a natural water repellent).

PAINTS

***INTRODUCTION***

Paint is a product formulated to protect and decorate mainly metallic and wooden surfaces. Paint has three main ingredients.

Pigments, which scatter and absorb light, so that the paint covers up the surface underneath and decorates it with color.

* Polymers, which hold the pigment to the surface by forming a smooth plastic film as the paint dries and sets. In gloss paints the film-forming polymers are alkyd resins; in emulsion paints, they are latex polymers.
* A vehicle, which is a liquid in which the other ingredients are dissolved or dispersed. In gloss paints, a vehicle is traditionally a hydrocarbon solvent. In emulsion paint it is water.

***CHARACTERISTICS OF AN IDEAL PAINT:***

• It should be chemically inert.

• It should be weather resistant.

• It should be non-toxic.

• It should have a suitable consistency which is generally determined by PVC.

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***TYPES OF PAINTS:***

1. Varnishes

Varnishes are organic compounds used as protective coating similar to paints. But the only difference is that varnishes do not contain coloring substances, i.e., pigments. Varnishes are classified under two heads:

• Oleoresinous varnishes and

• Spirit varnishes.

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• Spirit varnishes.

• Oleo resinous varnishes and

• Spirit varnishes.

Oleo resinous varnishes are the solutions of one or more than one natural or synthetic resins in drying oil and a volatile solvent. While the spirit varnishes are solutions of resins in volatile solvents only, generally methanol and ethanol. For the Oleo resinous varnishes, the formation of the film is due to the polymerization of the oil and in the case of spirit varnishes the film formation is due to only solvent evaporation.

Oleo resinous varnishes are also classified as:

1. ‘Long oil’ varnishes have high proportions of drying oil
2. ‘Short oil’ type contains a lower proportion of drying oil

‘Medium oil’ contains the proportion of drying oil intermediate between the two. The classification is based on the use of drying oil in gallons per 100 lbs. of resin.

1. Lacquers

Lacquers are dispersion or solution of a film-forming material (like nitrocellulose), resins, and plasticizers in solvents and or diluents. The purpose of using lacquer is for protective and decorative aspects. The lacquer dries from the surface on which it is applied by simple evaporation of the volatile constituents, i.e., solvents.

1. Enamels and Japans

Pigmented varnishes or lacquers are known as enamels. Japans are closely related to enamels. Carbon black is added in deep black Japanese. Enamels are brushed or sprayed on the surface and finally hardened by baking. The deep black Japans are based on boiled linseed oil and are made by cooking linseed oil with litharge at 230 degrees centigrade for 5 hrs. The product is called lead oil. This lead oil is mixed with kerosene (thinner) and asphalt. These Japans are applied and baked at 200 degrees C for a few hours.

1. Emulsion paints

Emulsion paints are those paints in which water is used in place of organic solvents as thinner. Emulsion paint is an emulsion of two phases viz.:

• Water and

• The vehicle of film-forming material (a synthetic resin or latex).

The latex is dispersed in water using a dispersing agent which acts as a binder. Pigments and extenders are dispersed in such an emulsion. Emulsifying agents or surface-active agents, stabilizers, driers, anti-foaming agents, and preservatives are also added.

***Advantages of an emulsion paint***

• Emulsion paints can be applied on the surface of metal or wood very easily.

• Emulsion paints dry quickly.

• More durable and more impermeable to dust and dirt.

• They can be applied simply with a brush.

• The surface on which the emulsion paint is applied can be easily washed with water.

• They are free from fire risks.

1. Distempers

Distempers are water paints comprising pigments, extenders, binders, and water as a dispersing medium. The distempers have:

1. Good covering power
2. Ease of application
3. Durability

The disadvantage of distemper is that it is not moisture-proof.

***SPECIAL PAINTS:***

1. Fire-resistant paints
2. Chemical-resistant paints
3. Luminous paints.
4. Marine paints.
5. Emulsion paints or latex paints.
6. Metal paints.

***APPLICATION OF PAINTS:***

Paint can be applied as a solid, a gaseous suspension (aerosol), or a liquid. Techniques vary depending on the practical or artistic results desired.

As a solid (usually used in industrial and automotive applications), the paint is applied as a very fine powder, then baked at high temperatures. This melts the powder and causes it to adhere to the surface. The reasons for doing this involve the chemistries of the paint, the surface itself, and perhaps even the chemistry of the substrate (the object being painted). This is called "powder coating" an object.

As a gas or as a gaseous suspension, the paint is suspended in solid or liquid form in a gas that is sprayed on an object. The paint sticks to the object. This is called "spray painting" an object. The reasons for doing this include:

• The application mechanism is air and thus no solid object touches the object being painted;

• The distribution of the paint is uniform, so there are no sharp lines;

• It is possible to deliver very small amounts of paint;

• A chemical (typically a solvent) can be sprayed along with the paint to dissolve together both the delivered paint and the chemicals on the surface of the object being painted;

• Some chemical reactions in paint involve the orientation of the paint molecules.

In the liquid application, paint can be applied by direct application using brushes, paint rollers, blades, scrapers, other instruments, or body parts such as fingers and thumbs.

REFERENCES

* 1. Sharma Ram, A textbook of Engineering Chemistry for BE, 2068
  2. Srinivas B.N., Engineering Chemistry
  3. Gautam Shree Dhar, Comprehensive Engineering Chemistry, 2077, first edition