Ques: Justify the statement

ⓐ Natural rubber is unsaturated hydrocarbon.

ⓑ Rubber is a polymer of isoprene unit.

ⓒ Each C_5H_8 unit of natural rubber contains only one double bond.

Ans:

ⓐ Natural rubber is a polymer made up of repeating units of isoprene (2-methyle-1,3-butadiene), which is an unsaturated hydrocarbon. Isoprene has two carbon-carbon double bonds in its structure, which makes it an unsaturated hydrocarbon. The repeating units of isoprene in natural rubber give it its characteristic elasticity and stretchiness.

The unsaturation is natural rubber can be confirmed by performing a simple chemical test, such as the bromine water test. Bromine water (Br_2) is a reddish-brown liquid that reacts with unsaturated compounds to form a colorless product. When natural rubber is treated with bromine water,

the unsaturated double bonds in isoprene react with the bromine to form a colorless dibromo compound This reaction is shown below:

Natural rubber + Br_2 ⟶ Dibromo compound + HBr
(colorless)

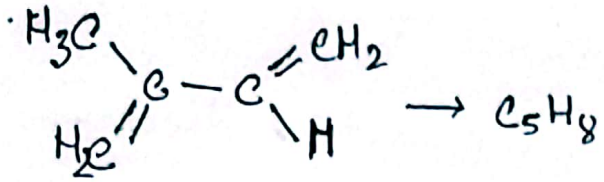
Another test that can be used to confirm the unsaturation in natural rubber is the ozonolysis test. In this test, ozone (O_3) is used to break the carbon-carbon double bonds in the unsaturated hydrocarbon. The product formed in an ozonide, which can be further treated with a reducing agent to form an aldehyde or a ketone. The reaction of natural rubber with ozone is shown below:

$$\{C_5H_8\}_n + 3O_3 \longrightarrow n(C_5H_8O_3)_n$$

$$n(C_5H_8O_3)_n + 6(CH_3)_2S \longrightarrow n(C_5H_8O)_n + 6(CH_3)_2SO$$

Therefore, based on the above chemical tests and the structure of isoprene, we can conclude that natural rubber is an unsaturated hydrocarbon.

(b) Rubber is a polymer made up of repeating units of isoprene, which is a monomer molecule composed of five carbon atoms and a branched structure that contains a double bond between the second and third carbons. The structural formula of isoprene is:



$\rightarrow C_5H_8$

The polymerization of isoprene occurs through a process called addition polymerization, in which the double bonds in the isoprene monomers are broken and new single bonds are formed between the carbon atoms, creating a long chain of repeating units. The reaction involves the use of a catalyst, typically a metal complex, such as stannous octoate or titanium trichloride. The polymerization reaction can be represented by the following equation:

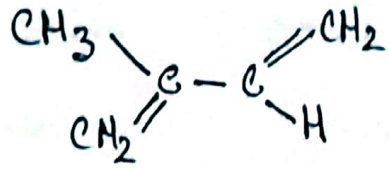
$$n\,C_5H_8 \xrightarrow{\text{Polymerization}} \left[CH_2\text{-}C(CH_3)=CH\text{-}CH_2\right]_n$$

To further confirm that rubber is a polymer of isoprene units, one can perform a chemical test, such as the bromine water test, which is commonly used to identify unsaturated compounds. When rubber is treated with bromine water, the bromine reacts with the double bonds in the isoprene units to form a colorless compound, indicating that the double bonds have been consumed by the reaction. The reaction can be represented by the following equation:

$$\left(C_5H_8\right)_n + nBr_2 \longrightarrow n\left(C_5H_8Br_2\right)$$

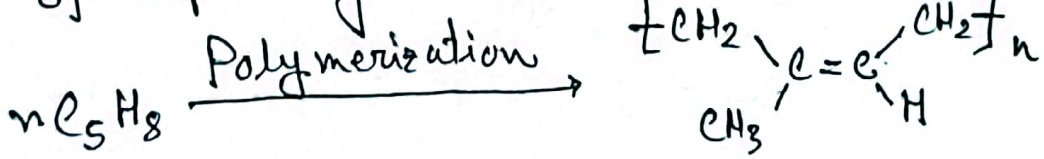
Therefore, based on the chemical composition and the structure of rubber, we can conclude that rubber is a polymer made up of repeating units of isoprene.

(c) Natural rubber is a polymer made up of repeating units of isoprene. Isoprene is an unsaturated hydrocarbon with two carbon-carbon double bonds in its structure.



(Isoprene)

The polymerization of isoprene occurs through a process called addition polymerization, in which the double bonds in the isoprene monomers are broken and new single bonds are formed between the carbon atoms, creating a long chain of repeating units.



Therefore, it can be concluded that each isoprene unit in natural rubber contains one double bonds.

Ques:
What is meant by compounding? Explicate different types of compound used for rubber compounding with example.

Ans: Compounding: Compounding refers to the process of combining various raw materials,

such as elastomers, fillers, curatives, plasticizers, process aids, and other additives, to creat a customized rubber compound with specific physical and chemical properties. The process of rubber compounding is aimed at achieving a balance of various properties, such as strength, durability, flexibility, heat resistance, chemical resistance, and other performance characteristics, that are tailored to meet the specific requirements of a particular application.

Rubber compounding involves the use of various types of ingredients that can be classified into several categories based on their function and chemical properties. Here are some examples of the different types of compounds used for rubber compounding:

1. Elastomers: Elastomers are the primary ingredient in rubber compounds and provide the rubber with its elastic properties. Example of

elastomers include natural rubber, styrene-butadiene rubber (SBR), butadiene rubber (BR), ethylene-propylene-diene monomer (EPDM), and nitrile rubber (NBR).

2. Fillers: Fillers are used to improve the mechanical properties of the rubber, such as tensile strength, abrasion resistance, and stiffness. Common fillers used in rubber compounding include carbon black, silica, calcium carbonate, and clay.

3. Reinforcing agent: Reinforcing agents are used to enhance the strength and durability of the rubber. Examples of reinforcing agents include aramid fibers, carbon fibers, and glass fibers.

4. Plasticizers: Plasticizers are used to improve the flexibility and processability of the rubber. Examples of plasticizers include oils, resins and esters.

5. Curatives: Curatives are used to improve the flexibility and processability of the rubber. Examples of plasticizers include include oils, resins, and resins.

6. Process aids: Process aids are used facilitate the mixing and processing of the rubber compound. Examples of process aids include waxes, stearic acid, and zinc oxide.

7. Antioxidants and antiozonants: Antioxidants and antiozonants are used to protect the rubber compound. Examples of process aids ~~include~~ waxes, ~~stearic~~ acid, antioxidants and antiozonants include phenols, amines, and quinolines.

8. Pigments and dyes: Pigments and dyes are used to add color to the rubber. Examples of pigments and dyes include carbon black, titanium dioxide, and phthalocyanine blue.

Ques: Briefly explain the different steps involved in fabrication of rubber goods.

Ans: The following are the basic steps involved in the fabrication of rubber goods:

1. Compounding: The first step in the fabrication of rubber goods is the compounding of the rubber material with various ingredients such as fillers, curing agents, accelerators, and other additives. The compounding process is crucial as it determines the properties of the final product.

2. Mixing: After compounding, the rubber compound is mixed to ensure that all the ingredients are evenly distributed throughout the material. This process can be done either by hand or using specialized machinery.

3. Molding: The next step involves molding the rubber compound into the desired shape using various techniques such as injection molding, compression molding, or transfer molding. The choice of molding technique depends on the type of product being

Produced and the volume of production.

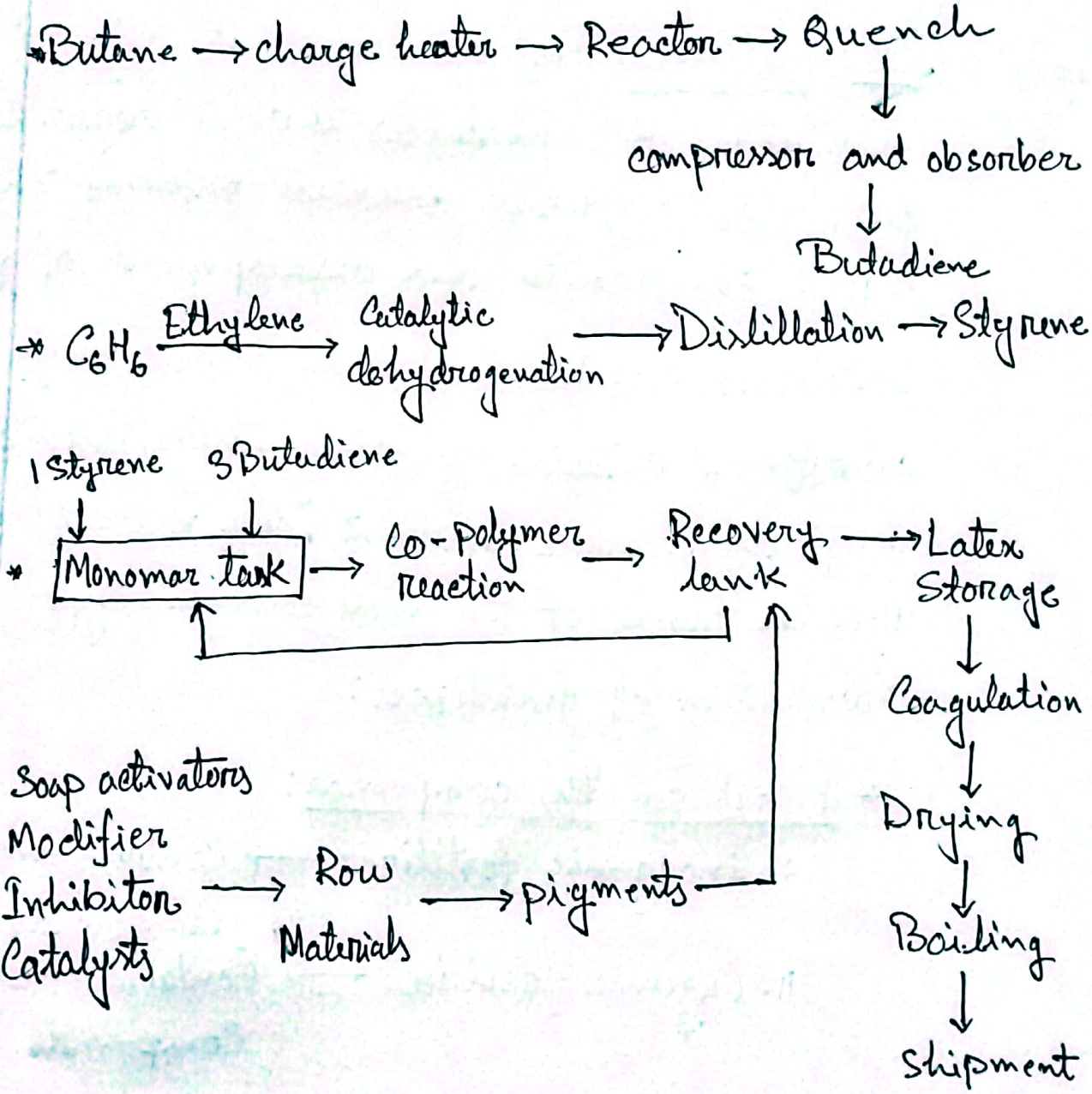
4. Vulcanization: Once the rubber material has been molded into the desired shape, it is then vulcanized. This process involves heating the material to a high temperature to cause the cross-linking of the rubber molecules, resulting in improved strength, durability, and elasticity.

5. Finishing: After vulcanization, the final step involves finishing the product by trimming excess material and adding any necessary finishing touches such as painting or polishing.

Overall, the process of fabricating rubber goods requires precision, expertise, and attention to detail to produce high-quality products that meet the required specifications.

Ques: Delineate the manufacturing process of SBR with flow chart.

Ans: The manufacturing process of SBR:



Fertilizer Industries

Ques: Define fertilizer. Explain different types of classification of fertilizer.

Ans: Fertilizer: Fertilizer refers to any substance or mixture of substances that is added to soil or plants to provide essential nutrients that support the growth and development of plants. Fertilizers can be classified in several ways based on different criteria, including their chemical composition, source, nutrient, and mode of application. Here are some of the most common types of classification of fertilizers:

* Based on the compounds:
  1. Inorganic fertilizer → Contains inorganic Compounds
  11. Organic fertilizer → Contains organic Compounds.

* According to agrochemical nature:
  1. Direct fertilizer → Contains the nutrient elements in the form of compounds which one directly assimilated by plants.

ii. Indirect fertilizer → Added to soil to improve chemical, mechanical, biological property, i.e. Ground dolomite and limestone.

* According to the number of basic nutrient elements:

i. Simple fertilizer → contain only one nutrient

ii. Double fertilizer → Contain two nutrients.

iii. Triple fertilizer → Contain three nutrients. That's why they are called Complete fertilizer.

iv. Micro fertilizer → Required in very small amount to stimulate the plant growth. i.e. boron, zinc.

v. Complex fertilizer → Contains several nutrient elements. Produced by chemical reaction.

* According to the solubility:

i. Water soluble → All nitrogenous and potash fertilizers.

ii. Soluble in soil acid → Most of the phosphates.

Ques: Define micronutrients. Mention the function of micronutrients for the growth of plant and vegetable.

Ans: Micronutrients: Micronutrients refer to essential nutrients required by plants in small quantities, typically less than 100 mg/kg of soil.

Here are some of the key micronutrients required by plants and vegetable, along with their functions:

1. Fe: Iron is essential for chlorophyll production which is necessary for photosynthesis. Iron deficiency can cause yellowing of leaves, stunted growth and reduced yields.

2. Mn: Manganese is involved in several key processes, including photosynthesis, respiration, and nitrogen metabolism. Manganese deficiency can cause yellowing of leaves, stunted growth, and reduced yields.

3. Zn: Zinc is involved in several metabolic processes, including enzyme function, protein

synthesis, and carbohydrate metabolism.

4. Cu: Copper is involved in several metabolic processes, including enzyme function and photosynthesis.

5. B: Boron is essential for cell wall formation and cell division, as well as for the uptake of other nutrients such as calcium and potassium.

6. Mo: Molybdenum is involved in nitrogen fixation, which is necessary for plant growth and development.

Micronutrients play a vital role in the growth and development of plants and vegetables, and their deficiency can cause a range of problems that can affect crop yields and quality. Therefore, it is essential to ensure the plants and vegetables receive adequate amounts of these micronutrients to ensure healthy growth and development.

Qus: Shortly describe the important function of phosphorous, abundant supply of phosphorous and deficiency of phosphorous as fertilizer.

Ans: Phosphorous is an essential nutrient for plant growth and development, and it plays several important function, including:

1. Energy transfer: Phosphorous is involved in transfer of energy within plant cells, which is necessary for growth and development.

2. Photosynthesis: Phosphorous is essential for the production of ATP, which is necessary for photosynthesis.

3. Root development: Phosphorous is important for the development of strong and healthy roots, which allows plants to absorb water and nutrients from the soil.

4. Flower and fruit Production: Phosphorous is important for flower and fruit production, as it helps plants to develop strong and healthy reproductive organs.

Abundant supply of phosphorus can promote healthy plant growth and development, leading to increased crop yields and better quality produce. However, excessive use of phosphorus-fertilizer can also cause environmental problems, such as eutrophication of water bodies.

Difficiency of phosphorus can cause stunted growth, poor root development, and reduced yields. Plants may also exhibit a dark green color, indicating a lack of phosphorus. Therefore, it is essential to ensure the plants receive adequate amounts of phosphorus fertilizer to promote healthy growth and development.

Ques: Describe the variouse types of drying process for the manufacturing of ammonium nitrate.

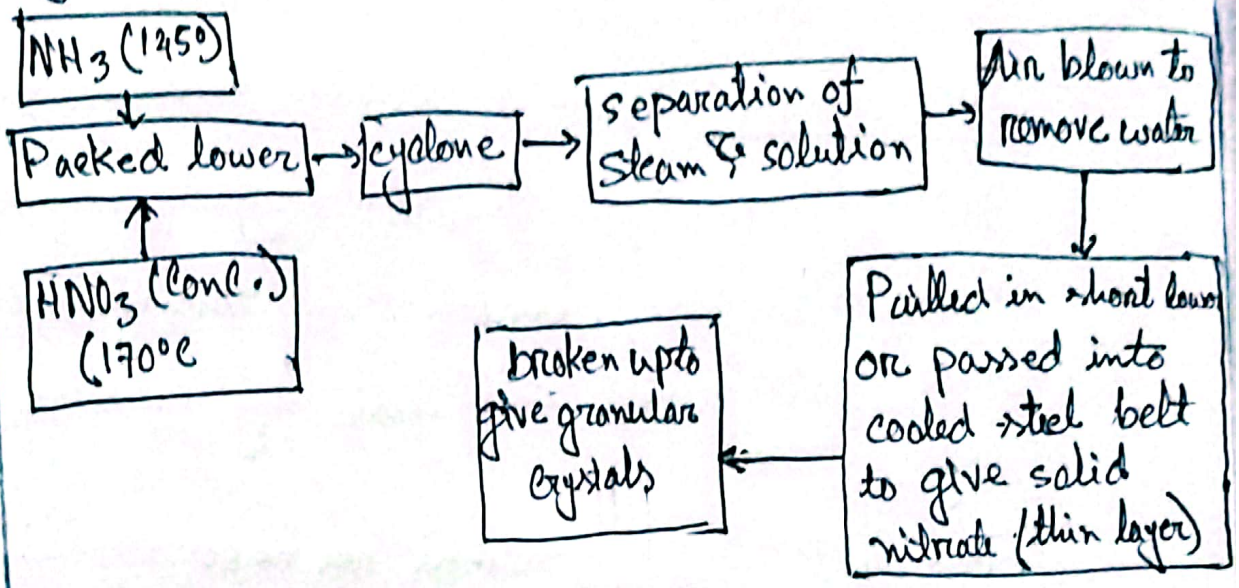
Ans: It is very difficult to dry ammonium nitrate. The drying temperature must be low to avoid melting. Various mathods of drying are available.

The methods has been described bellow.

Short Tower Prilling: Ammonium nitrate solution is concentrated to about 99.5% rather than the usual 35% is prilled in the usual way in a short tower, making use of the dust that strong solution solidifies faster. The lose trace at water may be removed by the process of evapuration than removing it in dryer. However, the quality of ammonium nitrate obtained by this method is not as good as it should be.

Stanyet Process: Superheated ammonia vapour (148°c) and concentrated nitric acid preheated to 170°C are allowed to react in a packed tower and the reaction mixture is then passed into a cyclone designed to seperate steam and solution quickly. Air is blown through the melt as a result of which water is removed from the melt to greater extent and a melt containing only about 0.25% moisture is produced directly. The melt

can be used directly, prilled in a short tower or passed into a cooled steel belt to give a thin layer of solid nitrate. The latter is subsequent by broken up to give granular crystals.



Bamag Process: Nitric acid and ammonia gas are pumped into a melt of ammonium nitrate at about 150°C, which is then cooled and converted into solid NH_4NO_3.

Crystallization Method: 83% solution is crystallised and the crystals are removed by centrifuging and then dried. This method has two major disadvantag

(a) Difficulty in growing crystals of adequate size at satisfactory rate.

(b) Poor physical conditions.

Pulp & Paper Industries

Qun: Define paper. Mention the ingredients that are necessary to produce an average metric ton of paper.

Ans: **Paper:** Paper is a thin material made from plant fibers, typically cellulose pulp, which have been macerated, beaten, and treated with chemicals and then formed into sheets by pressing and drying.

The following ingredient are necessary for products of 1 metric ton paper.

Water – 133000L
Sulphur – 15.5kg
$Mg(OH)_2$ – 20kg
Lime – 176.5kg
Salt Cake – 33kg
Caustic Soda – 29kg
Chlorine – .54kg
Starch – 53kg
Wood – 4 m^3

Tale – 28 kg
Synthetic – 10kg
Alum – 14kg
Clay – 60kg
Resin – 6kg
Dyes, pigment – 8kg
power – 4752 MJ
Capital investment (2017) – 706$
Work hour – 12.4 hr

Ques: Briefly explain the manufacturing of kraft pulping process.

Ans: The kraft pulping process is a chemical pulping process used to produce high-quality pulp from wood. Here's a brief overview of the process with some cooking conditions:

1. Wood chips: The process starts by preparing wood chips from softwood trees like pine or spruce.

2: Digester: The wood chips are loaded into a digester vessel and mixed with a solution of cooking liquor, which typically consists of about 12·5% solution of NaOH, Na_2S & Na_2CO_3, 58·6% NaOH, 27·1% Na_2S, 14·3% Na_2CO_3.

3. Cooking Condition: The digester is then heated to a high temperature, typically between 170-176°C, and pressurized to between 660-925 KPa. The cooking time can vary form 2-5 hours, depending on the desired degree of delignification and pulp quality.

4. Pulp Washing: Once the cooking process is

complete, the resulting pulp is washed to remove the cooking liquor and other impurities.

5. Bleaching: The pulp is then bleached with various chemicals, such as chlorine dioxide or hydrogen peroxide, to whiten it and improve its brightness and strength.

6. Drying: The final step is to dry the pulp which can be done using a variety of methods, such as air drying, drum drying, or flash drying.

Sugar Industries

Ques: Briefly contrive the manufacturing of sugar from sugarcane.

Ans: The manufacturing process of sugar from sugarcane involves several steps, including harvesting, milling, purification, and drying. Here's a brief overview of the process:

1. Harvesting: Sugarcane is typically harvested by hand or machine. The canes are cut close to the ground and collected in bundles for transportation to the mill.

2. Milling: At the mill, the sugarcane is crushed to extract the juice. The cane is passed through a series of rollers that crush and shred it to release the juice. The juice is then collected in large tanks.

3. Purification: The juice extracted from sugarcane contains impurities such as dirt, plant material, and other non-sugar substances. It is then clarified by heating and adding chemicals such as lime and sulfur dioxide. The impurities rise to the surface and are skimmed off, leaving behind a clear juice.

4. Boiling: The clear juice is then boiled in large pans to evaporate the water and concentrate the sugar. The syrup that remains is thick and brown, known as molasses.

5. Crystallization: The molasses is then placed in a centrifuge, which separates the sugar crystals from the remaining molasses. The sugar crystals are then washed, dried, and sifted to produce refined sugar.

6. Packaging: Finally, the sugar is packaged into bags, boxes, or other containers for distribution and sale.

Ques: Shortly describe about the decoloration and char filtration of raw sugar.

Ans: Decoloration: Raw sugar is often dark in color due to the presence of molasses and other impurities Decoloration involves treating the sugar with a decolorizing agent, such as activated carbon, to remove these impurities and lighten the color of the sugar. The decolorizing agent works by adsorbing the impurities onto its surface, leaving behind a clearer sugar solution. The sugar is than filtered to remove the decolorizing agent and any remaining impurities.

Char filtration: Char filtration is a process used to remove any remaining impurities in the sugar solution after decoloration. This involves adding a small amount of finely ground bonechar to the sugar solution. The bon char works by adsorbing any remaining impurities, including colorants, metals, and organic compound

The sugar is then filtered to remove the bone char and any remaining impurities. The resulting sugar is high quality and suitable for consumption.