(D) Extrusion Moulding :

Extrusion moulding is applicable to thermoplastic resins. It is mainly used for continuous moulding of thermoplastic materials into articles of uniform cross section. The thermoplastic ingredients are heated to plastic condition and then pushed by means of a screw conveyor into a die, having the required outer shape of the article to be manufactured. The finished product extruding out is cooled by atmospheric exposure or by blowing air or by spraying water. A long conveyor carries away continuously the cooled product.

The articles of uniform cross section like tubes, rods, strips insulated electric cables are manufactured by this technique.

As per the requirement extrusion moulding can be carried out in two ways:

(a) Vertical extrusion moulding.

(b) Horizontal extrusion moulding.

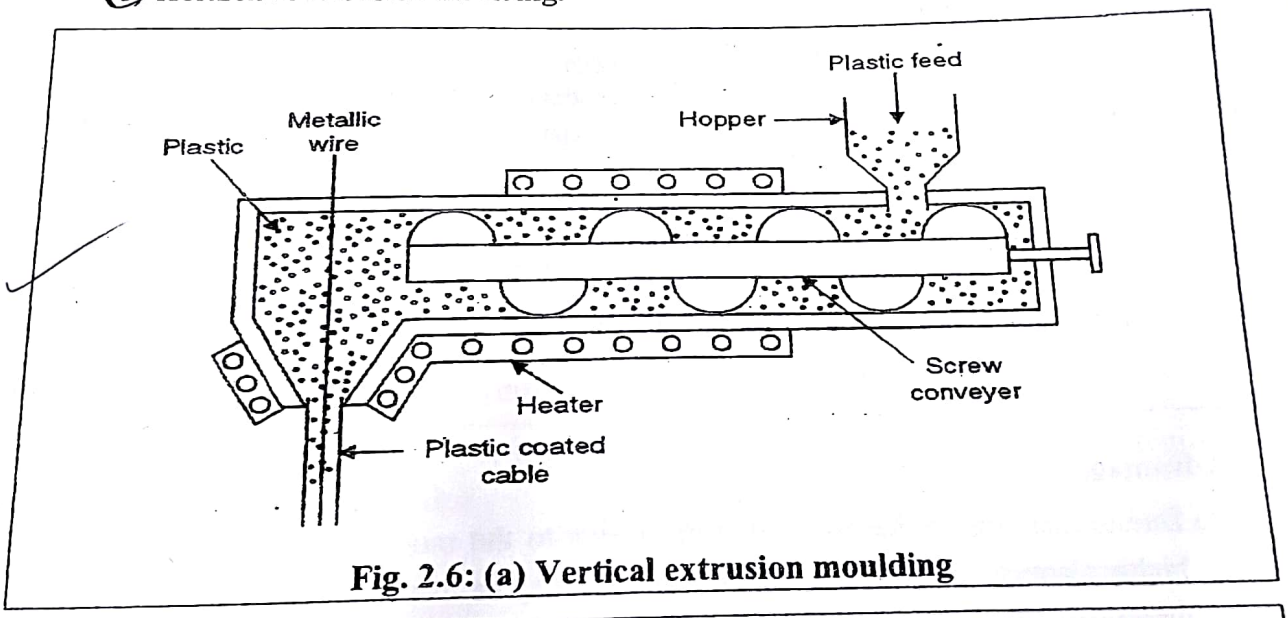


Fig. 2.6: (a) Vertical extrusion moulding

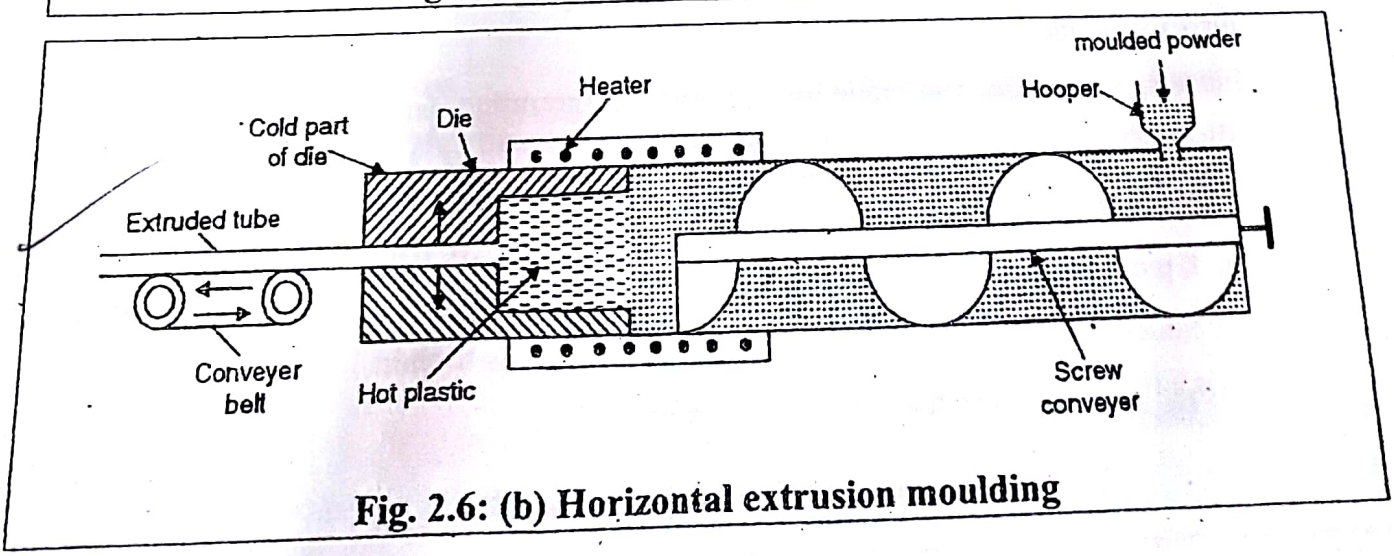


Fig. 2.6: (b) Horizontal extrusion moulding

Macromolecular or Covalent network
diamond, gemstones, ceramics, Carborundum

Ionic	molecular	macromolecular or Covalent network	metallic
		① diamond, gemstone, ceramics, Carborundum ② ③ corundum	
NaCl, $MgSO_4$, $Ca(NO_3)_2$, AlF_3	Solid CO_2, naphthalene, $C_6H_4Cl_2$ molecules.	atoms covalently bonded to each other	pure metals and alloys.
ions occupy lattice position			metal cations (valence electrons are delocalized)
brittle	Crumbly	Very brittle	malleable
Ionic bond hard	Vanderwaal force soft	Covalent-bond very hard	metallic bond variable
high m.p. (300-1000°C)	low (usually under 300°C)	very high over 1000°C	variable -39°C-Hg, 3415°C-W
no conductivity unless melted	no conductivity	no (insulators) conductivity	excellent.
Soluble in water, usually insoluble in nonpolar solvents	polar substance Soluble in polar solvents, nonpolar in Nonpolar solvent	insoluble	insoluble.

- It softens and becomes sticky in summer while becomes hard and brittle in winter.
- Hence, it is not used as such, but compounded and vulcanized to meet the requirements of its use.

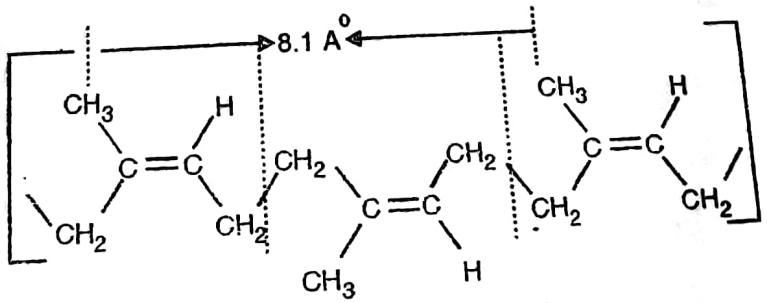
Smoked rubber

- To the coagulum, acetic acid or formic acid are added and the mixture is stirred thoroughly.
- This mixture is kept in tanks undisturbed for about 16 hours.
- A tough mass of coagulum is then formed.
- It is then passed through a series of rollers to form sheets; which are then hung for about 4 days in smoke house, where the temperature is in the range of 40°-50°C.
- The dry smoked rubber is translucent, amber coloured sheet, which does not get affected by bacteria or fungi.
- The properties of this type of rubber are also improved further by compounding and vulcanization.

1.12.1.3 Structure of Natural Rubber

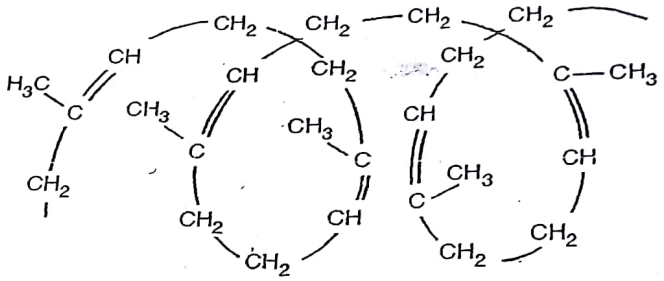
➤ [Dec. 2005 !]

Natural rubber is cis-polyisoprene which can be represented as,



Structure of Nature Rubber — [Cis - poly isoprene] Polymerised

- Being cis form, the polymer develops coiled structure, and hence possesses elasticity.
- Molecular weight ranges between 1 lak to 5 laks.
- When molecule is in linear / coiled form, the distance between methyl groups of the two monomeric units lying in same plane is 8.1A° (as shown in structure) and all – CH_3 groups are oriented outward.
- Coiled form can be represented as,



1.12.1.4 Properties and Drawbacks of Natural Rubber

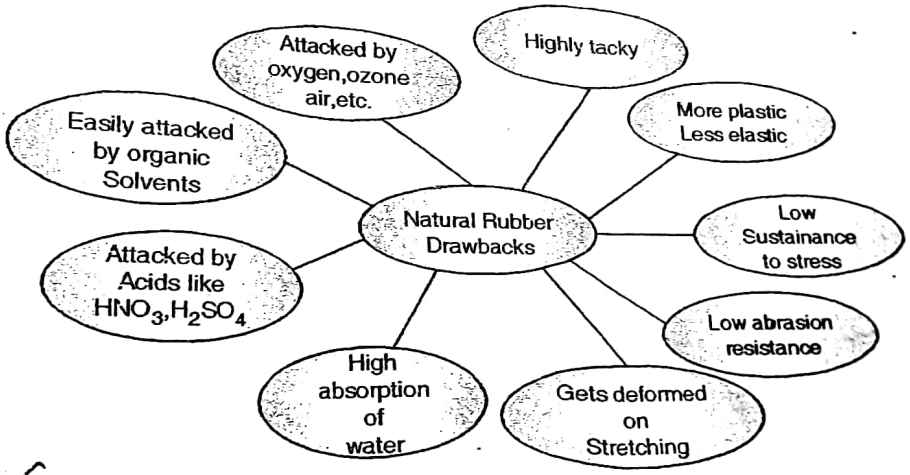
➢ [Dec. 2003 !]

- The natural rubber has following properties, (drawbacks) :

1. Its plasticity is greater than elasticity. It cannot sustain stress. Thus when stretched to a great extent, it undergoes deformation permanently.
2. It has large water absorption tendency, which makes it weak.
3. It has very low tensile strength (20 kg/cm^2).
4. Due to large percentage of unsaturation in its structure, it is easily attacked by various reagents such as HNO_3, conc. H_2SO_4, organic solvents, air, oxygen, ozone etc. and as a result gets gradually disintegrated.

5. It possesses high percentage of tackiness (property of developing stickiness on surface) which makes it difficult to store the rubber stocks.
6. Durability and abrasion resistance of natural rubber is very low.

- Thus the natural rubber does not have the desirable properties.
- Hence to make its maximum use, it is essential to improve its properties by means of certain catalyst.
- Any catalyst used to improve the drawbacks of natural rubber is known as a vulcanizing agent, and the process by which the undesirable properties of natural rubber are improved upon is known as vulcanization.



1.13 Vulcanization

➢ [Dec. 2004, May 2006, Dec. 2006, May 2007, Dec. 2007, May 2008, Dec. 2008, May 2009 !]

- To improve the properties of raw rubber, it is compounded with some chemicals like sulphur, H_2S, benzyl chloride etc.
- Most important of all the process of compounding (vulcanizing) is the addition of sulphur.

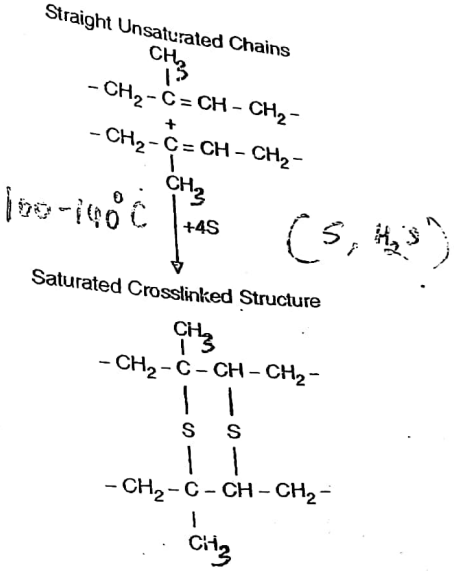
- The process consists of heating the crude rubber with sulphur to a high temperature.
- The sulphur combines chemically at the double bond in the rubber molecule. Vulcanization brings about stiffening of the rubber by a sort of cross-linking and consequently preventing intermolecular movement or sliding of rubber springs.
- The extent of stiffness or loss of elasticity of vulcanized rubber depends upon the amount of sulphur added.
- For example, a tyre rubber may contain 3 to 5% sulphur, but a battery case rubber may contain as much as 30% sulphur.
- The changes in properties that take place due to vulcanization is shown as below :

Undesirable properties		Improvement
Tacky		Non-tacky
Weak	Vulcanization →	Strong
Plastic		Elastic
Soluble		Insoluble

1.13.1 Vulcanizing Agents

- Generally, S, H_2S, O_2, Cl_2 and other organic compounds like quinone, di-azo-benzene or benzoyl peroxide etc. are used as vulcanizing agent.
- The temperature range is normally 100-140°C at which the sulphur cross linkages are developed making rubber tough and resistant to the attacks of various chemicals.
- The process makes rubber mechanically strong, and chemically resistant to attack of common chemicals.

- The vulcanization is also brought about by using certain oxides such as ZnO, MgO, HgO etc.



1.13.2 Advantages of Using Vulcanization

Vulcanized rubber possesses the following properties :

1. It has good tensile strength and extensibility when tensile force is applied.
2. It possesses low water absorption tendency.
3. It has higher resistance to oxidation and to abrasion.
4. It has much higher resistance to wear and tear.
5. It is a better electrical insulator.
6. It is resistant to organic solvent, fats and oils.
7. It is easy to manipulate the vulcanized rubber to produce the desired shapes.
8. Its useful temperature range is 40-150°C.
9. Its tackiness is only slight.

3. **Medicare**

Rubber is also used for making heart valves, transfusion tubing and padding for plastic surgery.

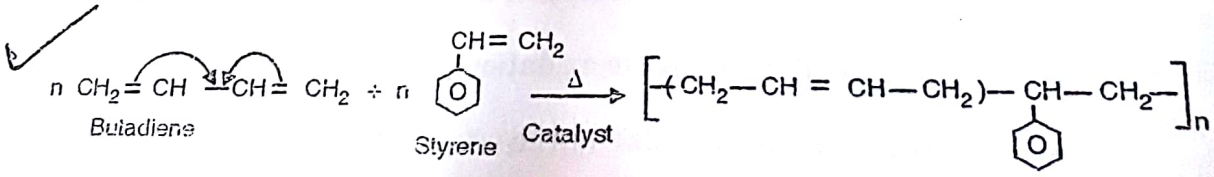
10. **Fuel**

Rubber like polysulphide rubber is used as a solid propellant fuel for rocket motors.

1.17 Co-polymerisation

➢ [May 2005, Dec. 2007, Dec. 2008, May 2009 !]

- Copolymerisation is nothing but specific type of addition polymerisation.
- In this the monomers of more than one type are involved.
- Copolymerisation has *unique importance* in the industry.
- This is because products formed by copolymerisation show the *specific properties* of the monomers.
- Sometimes such special properties are further enhanced or sometimes unique properties in the product as a result of the reaction between two different types of monomers.
- Thus copolymerisation gives rise to *variety* of the *products*.
- Thus several useful and commercially important polymers are formed by copolymerisation.



e.g. Styrene buladiene rubber (SBR – GR – S) Buna-S-Rubber

Acrylonitrile rubber NBR or GR-A

basis of the position in

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[Central Technological Institute, Maharashtra state]
Matunga, Mumbai-400019

SEMESTER EXAMINATION R&R - NOV - 2016
SEMESTER & COURSE I SEM.FYBTECH
SUBJECT(Code): **Applied Chemistry-I (CH1011T)**

DATE OF EXAM: 25/11/2016
TIME ALLOWED 3 HRS 9:30 to 12:30
MAX MARKS : 100

Instructions:
1. All questions are compulsory.
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary.
5. Illustrate your answers with neat sketches wherever necessary.

{Atomic weights: C = 12, O = 16, Ca = 40, Mg = 24, H = 1, Na = 23, Cl = 35.5, S = 32}

Q.1 (a) Rewrite following statements by *filling in the blanks.* (8) (10) 7

i) Hypoeutectoid steel contains.....:.....to.....% carbon.
ii) .....is an example for a polar and .....is for a non-polar polymers.
iii) Carborundum is an example of ..... refractories.
iv) .....is added in boiler water to prevent foaming.
v) .....is an example of extreme pressure additive.
vi) The interface formed between grains is called.....
vii) .....is the most important property of a lubricating oil under heavy load.
viii) In reverse osmosis, semi permeable membrane is made of .....
ix) .....is a measure of a material's resistance to localized plastic deformation
x) .....alloy of aluminum exhibits poor corrosion resistance.

(b) Answer the following.

i) What is plasticized PVC? How plasticizer affect PVC? State any two properties and two applications of PMMA. (4) 3 4.5

ii) Draw a neat labelled diagram of Pensky Marten's flash point apparatus. What are greases and how are they made? Which type of grease can be used in ball bearings. Justify. (6) 1

Q.2 *Answer the following:*

(a) Draw a neat labelled diagram for fabricating insulated electric cable. Write the structure of natural rubber. Write the effect of linear, branched and cross linked structure of polymer on the performance of plastic. (6) 3

(b) Calculate $\bar{M}_n$ and $\bar{M}_w$ of polypropylene with the following composition; $(-PP-)_{400}$ is 25%, $(-PP-)_{800}$ is 35%, $(-PP-)_{600}$ is 40%. (4) 2

(c) Write the cross linking reaction of phenol formaldehyde resins. Draw specific volume temperature diagram depicting the glass transition temperature. Write significance of T_g. (6) 4 4.5

(d) Classify polymers with example based on (i) effect of heat (ii) number of monomers (iii) growth mechanism (iv) types of atoms in the polymer. (4) 2

(P.T.O)

Q.3 *Attempt the following:*

(a) Draw a neat labelled diagram of ion exchange plant for water softening. Justify "Softening by ion exchange method is preferred over zeolite for boiler use". (6)

- Write the reactions for removing dissolved carbon dioxide and oxygen from boiler water.

(b) A standard hard water contains 15 g/L $CaCO_3$. 20 mL of this water required 25 mL of EDTA solution for titration. 100 mL of sample water required 18 mL of EDTA solution. After boiling the 50 mL of water sample required 6 ml of the EDTA solution.Calculate the temporary and permanent hardness of the sample water. (4)

(c) A water sample on analysis gave the following data: $CaCO_3$ = 12.5 ppm, $MgCO_3$ = 8.4 ppm,$CaCl_2$= 22.2 ppm, $MgCl_2$ = 9.5 ppm, CO_2 = 33.0 ppm, HCl = 7.3 ppm, $NaHCO_3$ = 16.8ppm, Na_2SO_4 = 14.2 ppm. Calculate the quantities of lime (85%) and soda (95%) required for softening 1 million litres of water sample. Also calculate temporary and permanent hardness of this sample. (6)

(d) Hardness of 800 litres of water sample was completely removed by passing through zeolite softener. The soffener required 40 litres of sodium chloride containing 110 g/litre of NaCl for regeneration. Calculate the hardness of water sample. (4)

Q.4 *Answer the following:*

(a) What are refractories and where are they used? Write significance of refractoriness and porosity. (6)

(b) What are culets?Why are they added during manufacturing of glass? Write composition, properties of soft glass. (4)

(c) How viscosity index influence the selection of lubricants for particular purposes? 6 g of oil was mixed with excess of 0.5 N KOH solution and heated with reflux condenser. The mixture required 15 mL of 0.45 N HCl. The blank titration required 45 mL of 0.45 N HCl. Find saponification value of oil. Comment on saponification value of mineral oil. (6)

(d) Draw a neat labeled diagram for thick film lubrication. Which type of lubricant can be used for gears? Justify your selection. (4)

Q.5 *Answer the following:*

(i) Define materials science. Classify engineering materials with example. Write any four properties of solids with ionic bonds. (6)

(ii) What do you mean by dislocations? How do they affect properties of material? State different mechanisms for strengthening of crystalline materials. (4)

(iii) Give the composition, properties and use of woods metal and German silver. (6)

(iv) Write any four purposes of making alloys. Write composition of any one heat resistant steel. (4)

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(6)

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Matunga, Mumbai-400019

SEMESTER EXAMINATION NOVEMBER 2015 R&P
SEMESTER & COURSE I SEM.FYBTECH
SUBJECT(Code): **Applied Chemistry-I (~~GH1001-T~~) (CH1011T)**

DATE OF EXAM: 26/10/2015
TIME ALLOWED: 3 HRS
MAX MARKS: 100
Time: 9.30-12.30 pm.

Instructions:
1. All questions are compulsory.
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary.
5. Illustrate your answers with neat sketches wherever necessary

{Atomic weights: C = 12, O = 16, Ca = 40, Mg = 24, H = 1, Na = 23, Cl = 35.5, S = 32, Fe = 56}

Q.1 (a) Rewrite following statements by *filling in the blanks.* (10)

i) Plastic used for making optical lenses is.....PMMA
ii) mineral oil/Bland in watches and.....mineral oil.....in gears are used as lubricants.
iii) A good refractory in general should have ..less../..porosity.(low)
iv) As the temperature increases the solubility of calcium sulphate....decreases
v) Nickel is a universal constituent of all heat resisting steels.
vi) ..Urea.....isa bi functional and ..Glycerol.....is a tri functional monomer.
vii) When the resistance to moving parts is only due to the internal resistance between the lubricant itself, lubrication is called.....Thick film.
viii) Dissolved oxygen in boiler-feed water is best removed by adding....Hydrazine
ix) ..Creep...is the time dependent deformation of a material under load.
x) Molar mass of polypropylene is .....if the degree of polymerization is 4000

(b) Answer the following in *short.*

i) Write the reaction of fatty acid soap with calcium permanent hardness of water.
ii) Iso tactic polymers are hard but atactic polymers are soft. Justify
iii) How the blended oils are superior to vegetable and animal oils.
iv) What is meant by the term 'structure' of a material? How is it significant?
v) Name the ferrous alloy which can't be welded and used for knives and saws for cutting tools. State any four advantages of Non-ferrous alloy

Q.2 *Answer the following:*

(a) With help of reactions differentiate the free radical polymer chain growth termination mechanism by coupling and disproportion. What is plasticized PVC? State two of its applications. (6)

(b) What do we mean by alloy steel? How can we make iron corrosion resistant? Write composition and uses of one such type of alloy. (4)

(c) State two limitations of zeolite process and two advantages of ion exchange process. (5)

An exhausted Zeolite softener was regenerated by passing 200 L of 10 %NaCl solution. How many litres of hard water sample having hardness 400

Plasticized 'PVC' = for making Continuous sheets (.1mm – 8mm) Employed for making raincoats, table cloths and curtains, electrical insulation like coverings of electric cable, injection moulding of articles like, toys, tool handling, foiled goods, ... components, plastic coated cloth, thermal insulating.

ppm can be softened using this softener? (5)

(d) Explain the mechanism of extreme pressure lubrication. Draw the structure of MoS_2 lubricant and how this works as lubricant.

Q.3 *Attempt the following:*

(a) A water sample contains following impurities: Ca^{+2} = 20 ppm, $MgCl_2$ = 95 ppm, CO_2 = 24 ppm, HCO_3^- = 133 ppm, $FeSO_4.7H_2O$ =13.9 ppm, Fe_2O_3 = 10 ppm. Calculate all types of hardness and the amount of L and S required for treating 1 million litres of water. (6)

(b) Define materials science and engineering. Explain with any two examples the reason for differences in properties of polymers and ceramics. (4)

(c) How the crystallinity of polymer affected by the chain & geometrical symmetry. Prove this with one example for each. Write any two effects of crystallinity on property of polymers. (5)

(d) What is refractory? Mention any four uses of refractories. Write any four characteristics of a good refractory. (5)

Q.4 *Answer the following:*

(a) Write the different reaction steps involved in the production of Bakelite. Write the principle of Injection molding of thermoplastics. (6)

(b) What are the steps involved in manufacturing of a glass? (4)

(c) Draw a neat labeled diagram of Abel's flash point apparatus (5)
Find the suitability of an oil as lubricant whose 5 mL required 2 mL of N/100 KOH during titration. (Density = .92 g/mL)

(d) Give classification of ferrous alloys with % of carbon. What are the advantages and disadvantages of addition of carbon to iron? (5)

Q.5 *Answer the following:*

(a) Why addition polymerization does produces polymer with very high molecular weight in a short period. (6)
For PVC there are 100 molecules of molecular weight 7,500, 200 molecules of molecular weight 12,500 and 300 molecules of molecular weight 17,500. Find $\bar{M}_n$, $\bar{M}_w$ and PDI and DP.

(b) What do you mean by plastic deformation? Explain how controlling grain size and alloying contribute to strength of materials. (4)

Or

What is meant by deformation and give its types? Why is the theoretical strength of metals much higher than that observedexperimentally?

(c) Discuss the necessity of making alloys with example? Write the composition & properties of the alloy used to make fire alarms. (5)

(d) Draw a neat labeled diagram for demineralization process of water. (5)
Calculate the hardness of water sample whose 20 mL required 30 mL and 20 mL of EDTA before and after boiling, 10 mL of $CaCl_2$ solution whose strength is equivalent to 300 mg of $CaCO_3$ per 200 mL required 20 mL of EDTA.