

**INDIAN RUBBER INSTITUTE
PGDIRI EXAMINATION – 2022**

Paper – III

Date : 26th March, 2023
Duration : 3 Hours

Time : 10.00 – 13.00 hrs.
Full Marks : 100

Rubber Materials

Answers should be illustrated with sketches wherever helpful

Total **FIVE** questions are to be answered. **Question number 1** is compulsory. Answer **four** from the remaining questions taking **two** from each group

GROUP – A

1. Multiple choice questions: select the correct answer from the given alternatives:

- (i) TDAE type of oil is used in which polymer
(a) BR (b) NBR (c) SBR 1712 (d) SBR 1723
- (ii) For tyre curing bag the most suitable rubber is
(a) CR (b) NBR (c) SBR (d) IIR
ageing resistance
- (iii) Select a cure system for best flex life of cured product:
(a) Semi EV (b) EV (c) Peroxides (d) Conventional
- (iv) Which of the following polymers possesses the highest resistance to Ethyl Alcohol?
(a) HNBR (b) NBR (c) CR (d) EPDM
- (v) In Latex Compounding the gelling agent used is
(a) Ammonia (b) Styrenated Phenol (c) Zinc Oxide (d) Sodium Silico Fluoride
- (vi) Polymer suffers from cold flow
(a) CR (b) NR (c) SBR (d) NBR
- (vii) The best flex life in a vulcanized rubber can be achieved when curing by
(a) EV (b) Conventional (c) Semi EV (d) None of the above
- (viii) The accelerator which can be used as curing agent without elemental sulfur
(a) MBT (b) CBS (c) TMTD (d) MOZ
- (ix) Carbon black having the lowest BET surface area is:
(a) N110 (b) N219 (c) N339 (d) N990
- (x) Acrylonitrile (ACN) content of most common grades of NBR is
(a) 10% (b) 33% (c) 67% (d) 45%
- (xi) The term VGC is associated with:
(a) Carbon black (b) Rubber processing oil (c) ZnO (d) Natural Rubber
- (xii) Which carbon black gives the best compression set resistance?
(a) HAF (b) ISAF (c) SRF (d) MT

- (xiii) Which polymer accepts maximum loadings of filler and oil?
 (a) EPDM (b) Silicone (c) PU (d) SBR
- (xiv) Pentachloro thiophenol is used in NR compounds to:
 (a) Improve OCT (b) Decrease MV (c) Improve ageing properties (d) None of them
- (xv) In textiles, the term "denier" is an indication of:
 (a) Strength of the fiber (b) Gauge of the fabric
 (c) Twist of the cord (d) Modulus of the yarn
- (xvi) Which of these thermoplastics elastomers has the best oil resistance?
 (a) TPO (b) TPU (c) SEBS (d) SBS
- (xvii) The ASTM series number for cold SBR gum rubber is:
 (a) 1000 (b) 1500 (c) 1700 (d) 2000
- (xviii) Which filler you should select for acid resistant tank lining?
 (a) CaCO_3 (b) ZnO (c) BaSO_4 (d) $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$
- (xix) The Crumb Rubber is used in rubber compound to facilitate
 a) Viscosity Control b) Dispersion c) Flow d) Reduce Mixing Time
- (xx) The best resilience is shown by
 (a) SBR (b) IIR (c) BR (d) NBR
 $(1 \times 20) = 20$
2. (a) What is the particle size of latex? How VFA of Natural rubber latex is measured?
 (b) What is the significance of the plasticity retention index (PRI) test?
 (c) Explain with examples the significance of using CV and EV systems of curing in NR compounds.
 (d) Write down the composition of natural rubber latex? Why it is necessary to concentrate natural rubber latex?
 $(4+4+ 6+2 \times 3) = 20$
3. a) Starting from field latex describe with a flow diagram how technically specified natural rubber (ISNR / SMR) is produced.
 b) What is Technically Specified Rubber (TSR)? What are the different Technical Specifications are considered for these type of rubbers?
 c) What is Gutta Percha, explain with the repeat unit.
 d) What are the different advantages of TSRs with respect to Conventional Rubbers? How Conventional Rubbers are classified?
 $6+(2+4)+3+(3+2)=20$
4. (a) What are Thermoplastic Elastomers and How are they different from thermoset Elastomers?
 (b) Mention different types of thermoplastic elastomers available showing the structural formulate and their main applications?
 (c) What is the TPVs?
 $(7+10+3) = 20$

GROUP- B

5. (a) Name a few non-black filler and arrange them in order of their reinforcing ability?
 (b) How following characteristics of a filler when added will affect processing behavior and vulcanized properties of a rubber compound.
 (i) Particle size, (ii) Structure, (iii) Surface characteristics, (iv) pH., (v) Surface area
 (c) What is the ASTM Nomenclature of N-219 stands for?
 (d) Discuss about the versatile uses of zinc oxide in rubber compounds.

(4+10+2+4) = 20

6. (a) What are the limitations of butyl rubber?
 (b) Describe briefly the manufacture process of butyl rubber.
 (c) What are the curing systems used for butyl rubber? Name each product where such system is preferred.
 (d) What are the basic differences between random and block copolymer?
 (e) Discuss one of the methods of production of reclaimed butyl rubber from scrap rubber with its major applications

2+7+4+3+4 = 20

7. (a) Just mention the function of each of the following ingredients in rubber compounds :
 (i) ethylene thiourea, (ii) ZMBT, (iii) p-nitroso benzene, (iv) DOP, (v) zinc oleate, (vi) mercapto silane, (vii) azodicarbonamide, (viii) antimony trioxide, (ix) resorcinol.
 (b) Identify the rubber used in the formulation according to the sequence of mixing & compounding ingredients used. Justify your answer.

| Mix 1 | | Mix 2 | | Mix 3 | |
|-----------------|-----|-----------------|-----|-----------------|-----|
| Rubber 1 | 100 | Rubber 2 | 100 | Rubber 3 | 100 |
| ZnO | 5.0 | ZnO | 5 | MgO | 5 |
| Stearic Acid | 2.5 | Stearic Acid | 1.0 | Carbon Black | 50 |
| Oil/Plasticizer | 5.0 | Sulphur | 1.2 | Antioxidant | 1.0 |
| Carbon Black | 50 | Carbon Black | 50 | Oil/Plasticizer | 5.0 |
| Antioxidant | 1.5 | Antioxidant | 1.0 | Accelerator | 1.2 |
| Accelerator | 0.9 | Plasticizer/Oil | 5.0 | Sulphur | 0.5 |
| Sulphur | 2.5 | Accelerator | 1.5 | ZnO | 5.0 |

What advantage you will realize if you blend BR with NR & SBR?

3x2+4+10=20

8. Write short notes on **any four** of the following:
 (a) Advantage & disadvantage of peroxide curing.
 (b) Fluorocarbon Rubbers
 (c) Insoluble sulphur
 (d) Retarders
 (e) Reclaim Rubber
 (f) Flame retardants and smoke depressant

(4 x 5) = 20