

INDIAN RUBBER INSTITUTE
DIRI EXAMINATION – 2023

Paper – III

Date : 10th March 2024
Duration : 3 Hours

Time: 10.00 – 13.00 hrs.
Full Marks: 100

RUBBER Materials, Rubber Compounding and Reinforcement

Answers should be illustrated with sketches wherever helpful
Question number 1 is compulsory. Answer four of the remaining questions, taking two from each group.

GROUP – A

1.(a) Choose the right answers from the given alternatives:

- (i) Which rubber demonstrates the best gum strength?
(a) CR (b) NR ✓ (c) SBR (d) EPDM
- (ii) Which of these rubbers has the best low-temperature flexibility?
(a) SBR (b) ECO (c) Silicone ✓ (d) FKM
- (iii) Which type of compound is the most staining type of anti-oxidant?
(a) Phenol (b) Phosphate (c) Amine ✓ (d) Carboxylic acid
- (iv) Which materials are commonly used as a curative for EPR compound ?
(a) Lead oxide (b) Peroxide ✓ (c) Sulfur (d) Resin
- (v) Nylon is a :
(i) Polyester (ii) Polyimide (iii) Polyamide ✓ (iv) Polycarbonate
- (vi) Bonding agent used for fabric rubber bonded product is.
(a) Chemlok (b) RFL ✓ (c) PF resin (d) Cl resin
- (vii) One of the major drawback of Polybutadiene Rubber is :
(a) High Rebound Resilience (b) Poor Processability ✓
(c) High Heat resistance (d) Resistance to Polar solvents
- (viii) Wood rosin is used in Rubber compounds as :
(a) Crosslinking agent (b) Tackifier ✓ (c) Peptiser (d) Accelerator
- (ix) EPDM is
(a) Monomer (b) Dimer (c) Copolymer (d) Terpolymer ✓
- (x) Which of the following oils will have lowest aniline points?
(a) Aromatic oil ✓ (b) Paraffinic oil (c) Napthenic oil (d) Vegetable oil
- (xi) The Dry rubber content of centrifuged natural latex is approximately
(a) 60% ✓ (b) 50% (c) 70% (d) 45%
- (xii) Which of these blends would give good abrasion and low heat build up?
(a) NR-SBR (b) NR-BR ✓ (c) BR-SBR (d) IIR-SBR

- (xiii) Dicumyl Peroxide (DCP) is used as
 (a) Peptiser (b) Cross-Linking Agent (c) Accelerator (d) None of the above
- (xiv) MC wax is used in rubber primarily as a :
 (a) Process aid (b) Antioxidant (c) Antiozonant (d) Activator
- (xv) Identify the blowing agent used in rubber:
 (a) ADC (b) DPG (c) ZMBT (d) ZDBC

- (b) Write the full form of the following
 EPDM, MVQ, MBT, SAF, HAF

15 x 1 + 5 x 1 = 20

2. (a) Give different classifications of Natural Rubber.

(b) What is Guttapercha? What is different between Guttapercha and Natural rubber based on the structure of its repeat unit and properties?

(c) What are the Initial Plasticity Number and Plasticity Retention Index? Explain the significance of both terms about Natural Rubber.

(d) What will be the impact if Nitrogen and dirt content is increased in NR or NR compound?

6+4+6+4 = 20

3. (a) Define the following:

(i) Sustainability & Sustainable Development

(ii) Linear & Circular Economy

(iii) Carbon Net Zero

(iv) ESG & CSR

(v) Sustainable & Renewable Material relevant to Rubber Industry.

(b) Explain 4 'R' Strategy in circular economy with example relevant to the Rubber Industry

5 x 2 + 10 = 20

4. (a) What do you mean by a technologically compatible blend? Give an example of a miscible rubber-plastic blend.

(b) Select suitable rubber/rubber blends for the following application, giving reasons for the same

(i) Inner liner for the tubeless tyre (ii) Tyre curing bag (iii) High voltage cable insulator

(iv) Aerotyre (v) Shoe soles

(c) Select a suitable curing agent for your suggested rubber/rubber blends for the above-mentioned products.

(6+3+4+7) = 20

GROUP - B

- 5 (a) What do you mean by CV, Semi-EV and TV curing system applied to NR compounding? How its affect on properties, like weather or heat resistance and flexibility?

(b) Name a few important non-black fillers.

(c) Give one example of each of the following :

(i) anti-oxidant, (ii) ultra-fast accelerator, (iii) vulcanization activator, (iv) peptizer

(v) extender, (vi) blowing agent, (vii) tackifier, (viii) post vulcanization stabilizer, (ix) retarder, (x) eco-friendly oil.

(7+3+10) = 20

⊙ EPDM - Ethylene Propylene Diene monomer
 MVQ - methyl Vinyl Silicone rubber
 MBT - mercapto Benzothiazole
 SAF - Super abrasion furnace Black
 HAF - High abrasion furnace Black

6. (a) Give examples of four important rubber products where textile is used for reinforcement.
Name the type of textile material and form, in which it is used in the above examples.
- (b) What do you mean by the following terms:
(i) Tenacity (ii) Moisture sensitivity (iii) Tex.
- (c) Briefly discuss how steel cord can be bonded with rubber.

(8+6+6)= 20

7. (a) A compound is given below:

<u>Ingredients</u>	<u>phr</u>	<u>Specific gravity</u>	<u>Cost (Rs.per kg)</u>
NR	100	0.92	210
ZnO	5	5.5	100
Stearic acid	3	0.85	50
Antioxidant TMQ	2	1.1	210
China Clay	40	2.65	4
N330 black	30	1.8	80
Aromatic oil	8	0.98	40
MBT/TMTD	10 (1.0)	1.3	300
TMTD	0.2	1.2	300
Sulphur	2.5	2.0	20

Calculate the specific gravity of the compound and the cost per unit weight and volume.

- (b) Suggest what changes would you make to:
- Reduce the heat build of the tread.
 - Improve the scorch safety of the compound.
 - Improve the ozone and weathering resistance of the tread.
 - Higher tensile strength.

(4 + 4) + 4 x 3 = 20

8. Write short notes on : (any four) :

- Dip coating of synthetic cords/fabrics
- Non black fillers
- Metal-rubber bonding
- Latex compounding
- Blowing Agent
- Different textile materials used in rubber industry.

4 x 5 = 20