

**INDIAN RUBBER INSTITUTE
DIRI EXAMINATION – 2011**

Paper – III

Date : 30th June, 2011
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** from the remaining questions taking **two** from each group

GROUP – A

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

- (i) Which polymer swells the least when immersed in petrol?
(a) BR (b) EPDM (c) SBR (d) CSM
- (ii) Which of the following rubbers possesses highest self protection against ozone?
(a) CR (b) NBR (c) SBR (d) EPDM
- (iii) Which of these blends would make a thermoplastic elastomer?
(a) PP-EPDM (b) PP-PVC (c) LDPE-ABS (d) NR-BR
- (iv) Which of these rubbers has best low temperature flexibility?
(a) SBR (b) ECO (c) MVQ (d) FKM
- (v) Which of these accelerators has maximum delaying action?
(a) MBT (b) CBS (c) ZDC (d) MBTS
- (vi) Which of the following filler possesses lowest average particle size?
(a) SRF (b) SAF (c) GPF (d) FEF
- (vii) Which type of compound are the most staining type anti-oxidant
(a) Amine (b) Phosphate (c) Phenol (d) Carboxylic acid
- (viii) Dry bonding agent used for textile-rubber bonded product is:
(a) Chemlok (b) Isocyanate (c) Brass (d) Hexa + Resorcinol
- (ix) The unit of tenacity of a filament is:
a) Tex b) Denier c) g/Denier c) Pa
- (x) Which of the following oils possesses lowest aniline point?
a) Napthenic b) Aromatic c) Paraffinic d) Vegetable oil

- (xi) Which rubber provides maximum abrasion resistance?
 (a) NR (b) SBR (c) BR (d) PU
- (xii) Which polymer exhibits maximum heat resistance properties?
 (a) CR (b) NBR (c) EVA (d) IIR
- (xiii) Which one is the heaviest filler in rubber compounds?
 (a) Carbon black (b) China clay (c) Silica (d) Barytes
- (xiv) ZnO is used as a curing agent for :
 (a) EPDM (b) BR (c) NBR (d) CR
- (xv) The term 'Mechanical Stability Time' is associated with :
 (a) Aaromatic oils (b) NR latex (c) Oil-extended polymers (d) None of above
- (xvi) Which of these polymers shows lowest tackiness?
 (a) NR (b) EPDM (c) NBR (d) SBR
- (xvii) Best flame resistant rubber is :
 (a) BR (b) IIR (c) Silicone (d) CR
- (xviii) What is the basis of grading ISNR?
 (a) Viscosity (b) Ash content (c) Dirt content (d) Cure rate
- (xix) Which of these rubbers has maximum air impermeability?
 (a) CR (b) CPE (c) Hypalon (d) IIR
- (xx) Paraffinic oil is most suitable plasticizer for :
 (a) NBR (b) SBR (c) Flouoroelastomers (d) EPDM
(1 x 20) = 20

2.

- (a) What is Guttapercha? Mention uses of DPNR.
 (b) List the methods that may be used to concentrate natural rubber latex. Give description of one of these methods.
 (c) How is DRC determined?
 (d) What are the advantages of superior processing rubber over conventional grades of NR?
(4+10+3+3) = 20

3.

- (a) Outline the preparation of a general purpose styrene butadiene rubber.
 (b) Compare the properties of SBR-1000 with SBR-1500.
 (c) Discuss the influence of acrylonitrile content of NBR on their properties.
 (d) Name and compare various grades of CR.
(10+3+4+3) = 20

- 4.
- What do you mean by technologically compatible blend? Give an example of miscible rubber-plastic blend.
 - What are the advantages of NR/BR blend over NR?
 - Give examples of heat fugitive (thermo reversible) crosslinks.
 - What are the advantages of TPVs over TPEs?
 - How does styrene content influence the properties of SBS? Name a few applications of SBS.

(4+3+3+4+6) = 20

GROUP - B

- 5.
- What are the main differences between the various types of furnace blacks now available?
 - When is insoluble sulphur used for rubber curing?
 - Explain the term 'structure' as applied to carbon black. How does 'structure' affect processing and vulcanizate properties?
 - 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) non-black non-reinforcing filler x) eco-friendly oil.

(4+2+4+10) = 20

6. A truck tyre tread compound is shown below:

<u>Ingredients</u>	<u>phr</u>	<u>Specific gravity</u>	<u>Cost, (Rs.per kg).</u>
NR	100	0.92	120
ZnO	5	5.5	90
Stearic acid	3	0.85	60
Antioxidant TMQ	1.1	1.1	250
Carbon black	35	1.8	50
Aromatic oil	4	0.98	40
CBS	0.6	1.3	300
Sulphur	2.5	2.0	30

Suggest what changes you would make to:

- Improve the tear strength of the tread.
- Improve the reversion characteristics of the compound.
- Improve the ozone and weathering resistance of the tread.
- Increase the hardness of the cured compound.

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

(2+2+4+2+10) = 20

- 7.
- What are meant by the terms Tex, Denier and Tenacity as applied to textiles?
 - Calculate the linear density and tenacity of a yarn when 500 cm. of that yarn weighs 5 gms. and its breaking load is 10 gms.
 - What is twist? What is its importance in textile application?
 - Discuss briefly the structural aspects of use of textile either in tyres or in conveyor belting.

(6+5+4+5) = 20

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

- (a) Flame retardants
- (b) Silica based reinforcing filler
- (c) Cotton vs. nylon as textile material for rubbers
- (d) Manufacture of crumb rubber
- (e) Facticees
- (f) Pre-vulcanised latex

(4 x 5) = 20