INDIAN RUBBER INSTITUTE
PGD-IRI EXAMINATION – 2012

Paper – III

Date : 21st July, 2012 **Time : 10.00 – 13.00 hrs.**
Duration : 3 Hours **Full Marks : 100**

Rubber Materials

Answers should be illustrated with sketches wherever helpful
Total **FIVE** questions are to be answered. Each question carries 20 marks
Part A: Question No. **1** is **compulsory** and answers any **four** from the remaining questions taking **two** from each group.

Part-A

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

(i) Polymer used in insulation of household cable is:
(a) FKM (b) EPDM (c) Plasticised PVC (d) NR

(ii) The polymer which exhibit LOI value of _____ is suitable for flame resistant application:
(a) 10 (b) 15 (c) 20 (d) 30

(iii) Polymer which shows the best combination of heat and oil resistance:
(a) MQ (b) EPDM (c) VMQ (d) HNBR

(iv) Polymer which shows the best gum strength
(a) SBR (b) BR (c) NBR (d) NR

(v) Good stabilizing agent for NR latex
(a) Acetic acid (b) Sulfuric acid (c) Ammonia (d) Calcium carbonate

(vi) High dosage of ZDC is used as an accelerator in
(a) Tyre (b) Latex product (c) Conveyor belt (d) Hose

(vii) Wood resin is mainly used a
(a) Plasticizer (b) Flame retardant (c) Tackifier (d) Curative

(viii) Chemical used as a coagulating agent for NR latex is
(a) Ammonia (b) Sulfuric acid (c) Acetic acid (d) Calcium carbonate

(ix) Colloidal dispersion of sulfur is used as a curative for
(a) Tyre (b) Metal-rubber bonding (c) Latex product (d) Tank lining

(x) Best oil resistance is shown by
(a) CR (b) CHR (c) BHR (d) NBR

(xi) The most widely used textile for reinforcement of V-belt is
(b) Polyester (b) Aramid (c) Glass (d) Nylon

(xii) Which filler you should select for acid resistant tank lining
(a) $CaCO_3$ (b) ZnO (c) $BaSO_4$ (d) $Al_2O_3.3H_2O$

(xiii) T_g of silicone rubber is
(a) -100^0C (b) -67^0C (c) -55^0C (d) -120^0C

(xiv) 100% NR should be used for
(a) Cycle Tyre (b) Car Tyre (c) Solid Tyre (d) Aero Tyre

(xv) If acrylonitrile (ACN) content of NBR is ..... it shows the highest oil resistance
(a) 10% (b) 33% (c) 27% (d) 45%

(xvi) Which polymer suffers from 'cold flow'?
(a) NR (b) CR (c) IIR (d) NBR

(xvii) Which polymer accepts the maximum loadings of filler and oil?
(a) BR (b) Silicone (c) PU (d) SBR

(xviii) Salicyclic acid is used in rubber compounds as:
(a) Retarder (b) Antiozonant (c) Blowing agent (d) Dispersing agent

(xix) Rubber hot water bottle is made from:
(a) IIR (b) Silicone (c) CPE (d) NR

(xx) The ASTM series number for hot SBR gum rubber is:
(a) 1100 (b) 1500 (c) 1700 (d) 2000

(1 x 20) = 20

2.

a) Starting from field latex, describe how technically specified grades of Natural Rubber (ISNR or SMR) are produced.

b) What are the advantages of technically specified grades over conventional grades?

c) What is the significance of the plasticity retention index (PRI) test?

10+6+4 = 20

3.

a) Butadiene is an important petrochemical for the rubber industry. Explain why?

b) Describe briefly the manufacture of any butadiene-based copolymer.

c) What are the basic differences between random and block copolymer?

5+10+5 = 20

4.

a) Describe the grading system used for rubber grade carbon blacks.

b) What is meant by 'Structure' of carbon blacks?

c) What are the differences between N220 and N660 as far as processing and reinforcing properties are concerned?

10+3+7 = 20

Part - B

5. Select suitable polymer/blend, curative, plasticizer and filler for following applications. Justify your choice each ingredient briefly.
   (a) Non halogenated fire resistant cable with low smoke generation in the event of fire.
   (b) Rubber vulcanizates with following properties TS ≥ 25 MPa, EB ≥ 450 % with good fatigue resistance.
   (c) Metal bonded oil seal with good mechanical properties.
   (d) Rubber seal working in dry condition over temperature range -110 ^{0}C to + 130 ^{0}C.

5 x 4 = 20

6.
   a) What are thermoplastic elastomers (TPE) and how do they differ from conventional rubber?
   b) Name the different types of TPEs commercially available showing the structural formulate and mention at least one application of each.

10+10 = 20

7.
   a) Mention the most suitable elastomer(s) for each of the following, and give reasons why.
      i) Tyre curing bag for automobile tyre.
      ii) High voltage cable insulation.
      iii) Liquified petroleum gas tubing.
      iv) Inner tube for oil field hose.
      v) Flame retardant cover compound for conveyor belt.
   b) Write down a typical recipe for any one of the above items, justifying your choice in ingredients.
   c) Select suitable curing systems for EPDM and IIR.

2 x 5+6+4 = 20

8. Write short notes on (any five) -
   a) Plasticizers for NBR & IIR
   b) Retarders
   c) Semi-EV system
   d) Microstructure and properties of solution and emulsion SBR
   e) Extenders
   f) Mineral rubber
   g) Curing agent for FKM & Hypalon

4 x 5 = 20

Part - B

5. Select suitable polymer/blend, curative, plasticizer and filler for following applications. Justify your choice each ingredient briefly.
   (a) Non halogenated fire resistant cable with low smoke generation in the event of fire.
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   4 x 5 = 20