

INDIAN RUBBER INSTITUTE

PGD-IRI EXAMINATION – 2010

Paper - IV

Date : 30th June, 2010

Time: 14.00-17.00 hrs.

Duration : 3 Hours

Total Marks : 100

Rubber Product Manufacturing and Their Evaluation

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. Select the correct answer from the given alternatives:

- (i) Best curing system for metal-rubber bonding should be based on:
(a) Semi EV (b) EV
(c) Conventional (d) Peroxide
- (ii) Tyre sidewalls are made thin because.....
(a) For better heat dissipation (b) No abrasion is needed in side wall
(c) For better economy (d) None of these
- (iii) If the volume of the mould is V, then the volume of initial compound used for preparation of micro cellular rubber should be roughly
(a) 1.7 V (b) V
(c) 0.7 V (d) None of these
- (iv) For steering response.....pattern is used in a tyre tread
(a) Lug (b) Semilug
(c) Rib (d) Mud and snow pattern
- (v) The property associated with change of stress with time when a rubber sample is held under constant strain is :
(a) Creep (b) Stress relaxation
(c) Set (d) Fatigue
- (vi) Maximum moisture regains percentage of Nylon tyre cord is
(a) 4% (b) 6%
(c) 4.5% (d) 5.5%
- (vii) The polymeric material will be highly flammable if its LOI is
(a) 60 (b) 48
(c) 18 (d) 27

- (viii) Truck tyre cord is mainly derived from....
- (a) Cotton (b) Nylon
(c) Rayon (d) Polyester
- (ix) The most important property requirement for rubber compound in seal & gasket is.....
- (a) Elongation at break (b) Tensile strength
(c) Modulus (d) Compression set
- (x) Heat treatment is necessary forcord prior to be used in rubber product
- (a) Rayon (b) Carbon fiber
(c) Steel (d) Nylon
- (xi) For coagulation of latex the useful material is.....
- (a) Acetic acid (b) Silica
(c) NH₃ (d) CaCO₃
- (xii) Dry bonding agent used for fabric-rubber adhesion is based on.....
- (a) Chemlok (b) Hexa + resorcinol + silica
(c) Desmodur (d) None of these
- (xiii) Air craft tyre is based on.....
- (a) NR-SBR blend (b) NR-BR blend
(c) Pure NR (d) SBR-BR blend
- (xiv) Bursting strength of braided hose is given by the following formula:
- (a) $3N_s R \sin \theta / DL$ (b) $0.2N_s R \sin \theta / DL$ (c) $0.2N_s R \sin \theta / D$
(d) $0.2N_s R \cos \theta / DL$, where each term has its usual meaning.
- (xv) The breaking load of conveyor belt is equal to
- (a) Sum of tensile strength of top and bottom cover compound + sum of Strengths of top and bottom plies.
(b) Strength of individual ply x number of plies.
(c) Sum of strength of top and bottom rubber cover
(d) None of these
- (xvi) The usual formula for calculation of tear strength of rubber compound is ...
- (a) Breaking load/cross sectional area at the time of breaking.
(b) Breaking load/ original thickness of the sample.
(c) Breaking load/original cross sectional area of the sample.
(d) Load at 300% elongation/original cross sectional area.
- (xvii) Bias angle in bias ply and radial ply tyres are respectively
- (a) 54°, 90° (b) 65°, 45°
(c) 90°, 45° (d) 30°, 90°

- (xviii) For preparation of flexible high voltage cable for 15 KV power line the suitable polymer insulation will be
 (a) Nitrile rubber (b) PVC
 (c) XLPE (d) EPR/EPDM
- (xix) The included angle in classical V-belt is
 (a) 60° (b) 45°
 (c) 40° (d) 54°
- (xx) Holography is an important test for
 (a) Tyre (b) V-belt
 (c) Hose (d) Conveyor belt

1 x 20 = 20

2. (a) What are the important properties required for passenger car tyre tread compound
 (b) What is "Rolling Resistance" of a tyre? What is the significance of rolling resistance of a tyre with respect to automobile industries?
 (c) What are the means to reduce rolling resistance of passenger car tyre tread compound? Explain with reasoning.
 (d) How abrasion resistance can be increased in passenger car tread compound?
 (e) Arrange the following elastomers in the increasing order of abrasion resistance:
 (i) SBR (ii) IIR (iii) NR (iv) Hypalon (v) CR
 (f) What will be the effect of abrasion resistance if the rubber compound is
 (i) undercured (ii) overcured

(3+4+4+4+1+4) = 20

3. (a) Write appropriate units for the following measurement parameters:
 (i) Tensile strength and tear strength
 (ii) Abrasion Loss
 (iii) Loss Modulus
 (iv) Rebound resilience and Heat Build-up
 (v) Volume resistivity
 (vi) Maximum torque by MDR
 (vii) Thermal conductivity
 (viii) Rolling Resistance
 (ix) Acid Value
 (x) Surface area of Carbon Black
- (b) A rubber compound was found to give rebound angle of 30° using Dunlop Pendulum Tester. If the initial angle of the pendulum was 45° , calculate the rebound resilience of the rubber compound under test.

Further to get rebound resilience of 60% what should be the rebound angle of the pendulum? If initial angle is 45° ($\cos 30^{\circ} = 0.866$ and $\cos 45^{\circ} = 0.707$).

(c) A typical PCR tread compound contains 70 phr HAF black. Specific gravity of this compound is 1.138. What will be the effect of specific gravity of the compound if 20 phr of HAF black is replaced by 20 phr. Silica? What will be the effect on the following properties if carbon black is replaced by equal amount of silica?

- | | | |
|------------------------|--------------------------|---------------|
| (i) Rebound resilience | (ii) Abrasion resilience | (iii) Modulus |
| (iv) Tear Properties | (v) Grip | (vi) Tack |

(10 + 4 + 6) = 20

4. (a) What is V-belt? Where it is used?
 (b) What do you mean by classical V-belt and wedge type V-belt?
 (c) Describe one method of V-belt building and curing.
 (d) What do you mean by life testing of V-belt?

3+4+10+3 = 20

GROUP - B

5. (a) What are the different components of high voltage cable? Show with appropriate diagram?
 (b) What do you mean by armour & jacket in cable?
 (c) Formulate a flame resistant cable jacket compound and justify your formulation?
 (d) Define dielectric constant & loss factor and name some instruments where these two parameters can be measured.

5 x 4 = 20

6. (a) Mention a few important destructive and non-destructive tests for tyre. Briefly describe one of them.
 (b) How metal-rubber bonding is tested?
 (c) What are the important tests for oil seal and gaskets?
 (d) What are the different methods for measuring fabric to rubber adhesion strength?

5 x 4 = 20

7. (a) Describe briefly the manufacturing steps for braided hose.
 (b) Derive an equation for bursting strength of braided hose.
 (c) What is neutral angle? How braiding angle is related to neutral angle and performance of the hose?
 (d) Formulate an inner liner compound for oil resistant hose.

10 + 4 + 3 + 3 = 20

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

- (i) Effect of curing system on fatigue, compression set & heat resistance
- (ii) Manufacturing of a tennis ball
- (iii) Preparation of hand gloves from latex.
- (iv) Manufacture of rubberized gum boot.
- (v) Effect of base rubber filler, & plasticizer on metal-rubber bonding.
- (vi) Metal surface preparation for bonding with rubber.

5 x 4 = 20