INDIAN RUBBER INSTITUTE
PGDIRI EXAMINATION – 2019

Paper – IV

Date : 7th July, 2019
Duration : 3 Hours

Time : 14.00 – 17.00 hrs.
Full 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 answers from the given alternatives: (1 x 20) = 20

(i)   For a rubber compound Tan δ value at 60^0 gives an idea about
    (a) Tear Strength   (b) Abrasion resistance   (c) Rolling loss   (d) wet traction

(ii)   Endurance test is the test associate with
    (a) Footwear   (b) Tyre   (c) V-belts   (d) Cable

(iii)   Rotor of Mooney Viscometer rotates as a speed of :
    (a) 3 rpm   (b) 2 rpm   (c) 1 rpm   (d) 5 rpm

(iv)   Foxing is one of the components of:
    (a) Tyre   (b) Rain coat   (c) Rubber canvass foot wear   (d) Transmission belt

(v)   To cure a thick rubber product one should be
    (a) Shorter time at higher temperature,   (b) Shorter time at low temperature
    (c) Longer time at elevated temperature   (d) Longer time at lower temperature

(vi)   'Peel' test is associated with
    (a) Bond testing of fabric to rubber   (b) Moulded rubber   (c) Hose   (c) Fabric abrasion

(vii)   The textile-to-rubber adhesion strength is generally expressed as
    (a) Only breaking load irrespective of sample dimension   (b) Breaking load/width of the sample
    (c) Breaking load/thickness of the sample   (d) Breaking load/area of the sample

(viii) Double day light-press associated with product of
    (a) Tyre   (b) Hose   (d) V-belt   (c) Footwear

(ix)   Included angle in V-belt and braiding angel in house should be respectively
    (a) 54^0 & 44^0 (b) 30^0 & 44^0 (d) 40^0 & 54^0 (c) 64^0 & 54^0

(x)   The tern "Run-Flat" is associated with:
    (a) Conveyor Belts   (b) V-belt   (c) Tyre   (d) Hose

(xi)   If a solid rubber ball is freely falling from a height "X", bounce back to a height "Y", then the resilience of the ball can be estimated from.
    (a) $(1- \cos X)/(1-\cos Y)$ (b) $1+X/1-Y$ (c) Y/X (d) X/Y

(xii) The term "compression ratio" is relevant to :
(a) Compression moulding   (b) 2-roll mixing mill
(c) 3-roll calender   (d) Extruder

(xiii) In a braided hose, if the braid angle is greater than the neutral angle, the hose will;
(a) Have no change during service   (b) Decrease in diameter
(c) Decrease in length   (d) Elongate in the direction 45^0 to the hoop force

(xiv) Corona resistance test is related to
(a) Hose   (b) Tyre   (c) Cable   (d) V-belt

(xv) Aspect ratio of modern passenger car tyre is about
a) 30%   (b) 70%   (c) 100%   (d) 120%

(xvi) Skid resistance is a term related to
(a) V-belt   (b) Conveyor belt   (c) Tyre   (d) Hose

(xvii) Silane coupling agent is used in Cable insulating compound to improve
(a) Tensile strength & heat build up   (b) Over all mechanical & wet electrical properties
(c) Dielectric constant & loss factor   (d) Heat resistance & electrical resistance

(xviii) Magnetron is the source of energy for :
(a) Fluidized bed curing   (b) Microwave curing
(c) Roto curing   (d) Electron beam curing

(xix) Property associated with change of strain with time when subjected under constant stress is
(a) Set   (b) Creep   (c) Fatigue   (d) Stress relaxation

(xx) Life testing is the most important test for
(a) Tyre   (b) V-belt   (c) Hose   (d) Cable

$6+3+6+2+3) = 20$

2. (a) Draw a section diagram of a Bias ply tyre indicating its various components.
   (b) What are the advantages of radial ply tyre over Bias types?
   (c) Describe in brief the manufacturing process of auto passenger car tyre with a flow diagram.
   (d) What is PCI and why it is necessary in tyre manufacturing?
   (d) What are the important properties required for passenger car tyre tread compound?

$(9+5+6) = 20$

3. (a) Describe briefly the manufacturing steps of a braided hose?
   (b) Derive an equation for bursting strength of wrapped hose?
   (c) Calculate the bursting pressure of a hose of bore 50 mm with tube thickness of 2.5 mm being braided with 480 nos of steel wire having breaking strength of 18 kg each (Tan $54^0 44' = 1.414$ and Sine $54^0 44' = 0.82$)

$(4+5+6+5) = 20$

4. (a) Give the process flow chart of rubber to metal bonding including metal surface preparation.
   (b) What are the different methods of measurement of metal-rubber bond strength?
   (b) What are various process of manufacturing rubber articles from latex?
       Give example of products associated with each.
   (c) Write a suitable formulation for that latex product mentioning the function of each compounding ingredients used.

GROUP – B

5. The following carbon black filled natural rubber based compound is mixed in an internal mixer.   (7+5+6+2) = 20

	Phr	Sp. Gravity	Rs/Kg
Natural Rubber	100	0.92	250
Zinc oxide	5	5.50	200
Stearic acid	1	0.85	50
6PPD	1.5	1.10	200
N 550 black	60	1.80	50
Ppt, Silica	20	2.00	100
Process Oil	8.00	0.97	
CBS	1.0	1.30	20
Sulfar	2.5	2.00	170

a) Calculate the Sp. Gravity of the compound?
b) If the cost per kg. of the compound is Rs. 85/-, Calculate the cost per unit volume.
c) What are the function of 6PPD # CBS, Zinc oxide and Stearic acid in the above formulation.
d) What changes would you expect if N550 is replaced by N330?

6. (a) What is meant by " Standards and Specification"?.   (5+5+4+6) = 20
   (b) Write down briefly the basic aspects about quality assurance activity in a manufacturing unit.
   (c) What is the purpose of using a Mooney viscometer and Rheometer?
   (d) Draw a standard curve for Mooney viscometer and a Rheometer & explain.

6. (a) Give the process flow chart of rubber to metal bonding including metal surface preparation.   (4+5+6+5) = 20
   (b) What are the different methods of measurement of metal-rubber bond strength?
   (b) What are various process of manufacturing rubber articles from latex?
       Give example of products associated with each.
   (c) Write a suitable formulation for that latex product mentioning the function of each compounding ingredients used.

7. (a) Write briefly how the Rebound Resilience and Heat build-up of rubber compounds are measured?   (6+6+4+4) = 20
   (b) Explain, how the above both properties correlate with the performance of 'Truck Tyre Tread'?
   (c) Using a Dunlop Pendulum tester, a rubber compound was found to give a rebound angle of 30^0 with the vertical. If the initial angle of the Pendulum at its release point was 45^0 with the vertical, calculate the rebound resilience of the rubber compound under test. (Given $\cos 30^0 = 0.866$ and $\cos 45^0 = 0.707$)
   (d) Define the term "hysteresis" and "damping" as applied to rubber vulcanizates. Is there any relation between these two properties?

8. Write short notes on (any four)   (5 x 4) = 20
   (a) Manufacturing of rubber rolls
   (b) Rolling resistance
   (c) High voltage cable insulating materials and properties
   (d) Hardness testing of rubber
   (e) Tensile and Tear test for rubber vulcanizate
   (f) Structure of carbon black