INDIAN RUBBER INSTITUTE
PGDIRI EXAMINATION – 2011

Paper – III

Date : 30th June, 2011 **Time : 10.00 – 13.00 hrs.**
Duration : 3 Hours **Full Marks : 100**

Rubber Materials

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) Pine tar acts as a:
(a) Plasticizer (b) Retarder (c) Accelerator (d) Peptizer

(ii) Which of the following polymers possesses the highest resistance to sulfuric acid:
(a) NR (b) NBR (c) SBR (d) Hypalon

(iii) Polymer which has best combination of oil resistance, flame resistance & heat resistance:
(a) EPDM (b) NBR (c) CR (d) FKM

(iv) The most widely used textile reinforcement of aero-tyre is
(a) Polyester (b) Aramid (c) Glass (d) Nylon

(v) Which filler you should select for fire resistant, low-smoke cable jacket
(a) $CaCO_3$ (b) ZnO (c) $BaSO_4$ (d) $Al_2O_3,3H_2O$

(vi) T_g of NR is
(a) -100^0C (b) -67^0C (c) -55^0C (d) -120^0C

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

(viii) The accelerator which can be used as curing agent without elemental sulfur
(a) MBT (b) CBS (c) TMTD (d) MOZ

(ix) Peroxide curing system is not technically recommended for
(a) NBR (b) HNBR (c) IIR (d) EPDM

(x) Acrylonitrile (ACN) content of most common grades of NBR is
(a) 10% (b) 33% (c) 67% (d) 45%

(xi) The term VGC is associated with:
(a) Carbon black (b) Rubber processing oil (c) ZnO (d) Natural Rubber

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

(xiii) Which polymer accepts maximum loadings of filler and oil?
(a) EPDM (b) Silicone (c) PU (d) SBR

(xiv) Pentachloro thiophenol is used in NR compounds to:
(a) Improve OCT (b) Decrease MV (c) Improve ageing properties (d) None of above

(xv) Dinitroso pentamethylene tetramine is used in rubber compounds as:
(a) Retarder (b) Antiozonant (c) Blowing agent (d) Dispersing agent

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

(xvii) The ASTM series number for cold SBR gum rubber is:
(a) 1000 (b) 1500 (c) 1700 (d) 2000

(xviii) Suitable polymer blend for manufacturing Rice Dehusking Rollers is:
(a) NR/ SBR (b) NBR/ PVC (c) NBR/ PF (d) NR/ HSR

(xix) MST of NR latex should preferably be around:
(a) 400 secs. (b) 600 secs. (c) 900 secs. (d) 1200 secs.

(xx) The maximum limit of KOH number in NR latex is:
(a) 1.0 % (b) 0.5 % (c) 5 % (d) 10 %

(1 x 20) = 20

2. (a) Explain the use of Superior Processing NR.
   (b) What are the main differences between technically specified grades and conventional RMA grades of sheet rubber?
   (c) Explain with examples the significance of using semi-EV and EV systems of curing in NR compounds.
   (d) How does ISNR-5 differ from ISNR-20?

(4+6+ 6+4) = 20

3. (a) Mention important properties and applications for each of the following blends:
   (i) NBR/PVC (ii) NR/BR (iii) NR/BIIR
   (iv) NR/HSR (High styrene resin rubber master batch) (v) PP/EPDM
   (b) Select most appropriate polymer and filler for each of the following applications with proper reasoning.
   (i) White sport shoe sole
   (ii) Truck tyre
   (iii)Hard Battery boxes
   (iv)EPDM steam hose
   (v) Tank lining for sulfuric acid

(5 x 2 + 5 x 2) = 20

4. (a) Outline the manufacture of either NBR or IIR.
   (b) How does 'W' grade of CR differ from 'G' grade with respect to processing and vulcanisate properties?
   (c) What steps would you take to remove/ minimize the air entrapment problem in IIR compound during extrusion, calendaring and press-moulding?
   (d) Suggest a mix design of IIR compound with resin cure system.

(6+4+6+4) = 20

GROUP- B

5. (a) Discuss about the structure and particle size of carbon blacks and their influences in processing and vulcanisate properties.
   (b) Expand the grades of carbon blacks ------- (i) N 110 and (ii) N 660.
   (c) Discuss about the versatile uses of zinc oxide in rubber compounds.

(10+4+6) = 20

6. a) Calculate the specific gravity of the following compound

	Parts by wt.	Sp. Gravity
Natural Rubber	100	0.92
Zinc Oxide	5	5.56
Stearic Acid	1	0.85
HAF Black	50	1.80
Precipitated silica	10	2.00
Aromatic oil	8	0.97
TDQ type Antioxidant	1	1.10
CBS	1	1.30
Sulphur	2.5	2.00

(b) Cost per kg. of the above compound is Rs. 50/-. Calculate the per unit volume (m^3) cost.

(c) If 30 parts of Natural Rubber is replaced by equivalent parts of Polybutadiene Rubber in the above recipe, what will be the effect on the physical properties?

(d) What type and dosage of antioxidant should be added in the above compound to improve ozone resistance property?

(8+3+6+3) = 20

7. (a) Just mention the function of each of the following ingredients in rubber compounds :

(i) ethylene thiourea, (ii) ZMBT, (iii) p-nitroso benzene,
(iv) DOP, (v) zinc oleate, (vi) mercapto silane,
(vii) azodicarbonamide, (viii) antimony trioxide, (ix) calcium oxide
and (x) resorcinol.

(b) In binary acceleration systems, what is meant by additive and synergistic effects? Give examples for both with cure curves.

(c) How may reclaim rubber and factice be used to modify the processing properties of rubber compound?

(10+5+5) = 20

8. Write short notes on **any four** of the following:

(a) Advantage & disadvantage of peroxide curing.
(b) Blowing agents.
(c) Linear density and tenacity
(d) Cotton vs. Nylon as textile
(e) Retarders
(f) RFL dip on textile

(4 x 5) = 20