INDIAN RUBBER INSTITUTE
PGD-IRI EXAMINATION – 2013

Paper - II

Date : August 10, 2013 **Time : 14.00 pm - 17.00 pm**
Duration: 3.00 hours **Full Marks: 100**

RUBBER PROCESSING AND ENGINEERING

Question No. 1 is compulsory and answer **Four questions** from the remaining.

Answer should be illustrated with sketches wherever necessary
For Question No. 2 use graph paper.

1) Select the correct answer from the given alternatives :

i) In a master batch compound if the specific gravity is lower than the specification that means:

a) Less sulpher added
b) Less oil added
c) Less Carbon black added
d) None of the above.

ii) In a banbury mixing if large volume of liquid softeners and large volume of carbon black fillers are to mixed in EPDM rubber it is suggested to have –

a) Single stage / low speed mixing
b) Two stage / high speed mixing
c) Upside down mixing
d) Dough mixing.

iii) In the recent past a two roll calendar combination with extruder feeding is used for Rubber profiles. This equipment is known as –

a) Vacuum – vented extruder
b) Inverted "L" calendar
c) Roller – die – extruder
d) Cross head extruder.

iv) In a coloured compound the given colour is added at the end of the mixing cycle –

a) To save colour
b) As curing agent
c) To avoid oxidation
d) For better uniformity of mixing of colour

v) For a continuous process of a profile of a rubber compound it is suggested to have -

a) RAM extruder
b) Screw extruder
c) Strainer
d) None of the above

vi) The purpose of T C U in an internal mixer is –

a) To give hot water to the rotors
b) To give cold water to the chamber
c) To manipulate the temperature by operator to reduce the mixing time.
d) To maintain the mixing temperature for the consistent & quality output.

vii) Peripherally drilled roll design is superior to cored roll in 4-roll calendar, because –

a) The surface of the roll temperature can be quickly cooled or enhanced.
b) It has quick cooling system
c) T C U not required
d) It consumes more water

viii) Rapid plastimeter is used to test the PRI of –

a) Reclaim Rubber
b) De-vulcanized rubber
c) Green strength of ISNR
d) Moisture content of NR

ix) Optimum cure time (OCT) in Rheometer is calculated by –
a) Difference between minimum & maximum torque
b) Difference between minimum & maximum cure time
c) 90% of maximum time
d) Time required for attaining 90% of maximum torque.

x) High temperature & shorter curing time is preferred for –

a) Thicker moulded articles
b) Thin rubber moulded goods
c) Commonly for all NR products
d) None of the above.

xi) For GPRs the Mooney viscosity of compound is normally tested at

a) 75° C (b) 100 ° C (c) 175 ° C (d) 90° C

xii) To improve the homogenization and to eliminate porosity in extrudates it is preferred to use –

a) Dual extruder
b) T-head extruder
c) Pin barred extruder
d) Triplex extruder

xiii) "3T" process is required for processing –

a) Cotton ply tyre cords
b) Nylon tyre cords
c) Rayon tyre fabrics
d) Steel tyre cords

xiv) PCI means –

a) Pre compressed Inhibitor
b) Post cure inflation
c) Proper Curing Index
d) Pre-cost index

xv) ODR means –

a) Open-die-rheometer
b) Oxidative-die-resilient
c) Oscillating disc rheometer
d) Ordinary duplex rheometer

xvi) SI Unit of tensile strength of Rubber compound

a) MPa
b) Kg / meter
c) Nm
d) Ncm

xvii) The "Marching Modulus" is predominantly calculated in Rheograph of –

a) EPDM based compound
b) Butyl based tube compound
c) NR based tread compound
d) SBR based PC tread compound.

xviii) In a compounded rubber if the "Sulphur" ingredient moves from bulk to the surface, then the phenomenon is called as –

a) Frictioning effect
b) Blooming effect
c) Finishing effect
d) Sulphanization

xix) The complex configuration on moulded article are most likely made by ----------

a) Compression molding
b) Injection molding
c) RIM
d) None of the above

xx) ML_{1+8} at 125 ° C is related to –

a) SBR
b) IIR
c) NBR
d) NR

(20x1 = 20)

2. a) Write a neat sketch of –

i) Mooney Viscometer
ii) Moving disc Rheometer (MDR)

b) How do you apply the data of Viscometer & Rheometer during rubber processing?

c) Following experimental Time - Torque data is obtained from a Rheometer curve of a compound tested at 150 ° C

Time in seconds	Torque in Kg m
0	70×10^3
45	32.3×10^3
90	57.6×10^3
105	173×10^3
120	461×10^3
135	559×10^3
150	588×10^3
180	611×10^3
210	625×10^3
300	652×10^3
450	669×10^3
750	681×10^3
1200	686×10^3

Draw the rheograph and calculate the maximum and minimum viscosity, cure index and O C T from the graph.

(3 + 5 + 10)

3. (a) Explain with a neat sketch the effects of rpm of rotor, fill factor and temperature on quality of mixing in an internal mixture. Compare tangential and intermeshing type rotors from the point of view of mixing. How is friction ratio manipulated in an internal mixture?

(b) Describe the suitable mixing process of the following –

(i) NR compound with 50 phr of HAF carbon black
(ii) EPDM compound with 200 phr of GPF carbon and 150 phr of paraffinic Oil.

© A NR master batch is mixed in a F-270 Farrel Internal mixer of 1.10 specific gravity with 220 kg. batch weight at 50 revolutions per minute with inlet water temperature 22° C and outlet water temperature of 30 ° C. Calculate the fill factor of the batch.

(10 + 5 + 5)

4)

a) List out with neat sketchs the different configuration of calenders on the basis of its shape.

b) Describe the process flow chart of "Z" type 4-roll calender from L/O to W/up.

c) What are the three major gauge control systems adopted in calenders for achieving uniform gauges and explain.

d) Write down 4 major calendering defects and explain.

(5 + 5 + 5 + 5)

5)

a) Write a neat sketch of section view of typical hot feed extruder & label the main parts.

b) Write the objectives of 'Dual Tread' in truck tread compound & basic difference in compound formulation in dual tread compound.

c) Discuss the main factors which are influencing -

i) Extrusion temperature near to the extruder head.
ii) The tread temperature at the time of booking.

d) Explain the factors affecting the die swell.

(5 + 5 + 5 + 5)

6)

a) Explain neatly with the help of diagram the salient features of 'Screw-Ram' injection moulding machine.

b) Compare & contrast the merits and demerits of injection moulding process.

c) Define the % shrinkage..

d) A NR gum compound is cured in mild steel mould at 140° C in 28 " x 28" platen type curing press at room temperature of 30° C calculate the % shrinkage of the moulded article (given, co-efficient of Thermal expansion of NR= 216 x 10 - 6, Mild steel =11 x 10^{-6}, volume % of rubber and acetone extractable 99%)

(5 + 5 + 5 + 5)

7)

a) List down the various moulding techniques used in rubber industries.

b) Explain any curing techniques used for any two of the following products –

i) Tyre ii) Tube iii) Conveyor belt iv) Car window channel.

c) Explain the mould cleaning techniques normally adopted in rubber industries.

d) List out any four moulding defects and give remedial solutions.

(4 + 4 + 6 + 6)

8)

Answer any **FOUR** of the following –

a) Spreading operation
b) Saturated steam vs. temperature
c) To determine the specific gravity of a compound with an example.
d) Power integrated mixing internal mixer
e) Roller-die head extruder
f) Curing of thick-sectioned articles