INDIAN RUBBER INSTITUTE

PGD-IRI EXAMINATION – 2015

Paper - II

Date: 17th July, 2015 **Time: 14.00-17.00 hrs.**

Duration: 3 Hours **Full Marks : 100**

RUBBER PROCESSING AND ENGINEERING

Question No. 1 is compulsory. Answer **Four** questions from the remaining taking **Two** from each group.

Answers should be illustrated with sketches wherever required.

GROUP - A

1) Select the correct answer from the given alternatives :

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

a) Less sulphur added

b) More process oil added

c) More carbon black added

d) None of the above.

ii) In a banbury mixing if large volume of process oil and large volume of carbon black & china clay fillers are to be 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 an extruder feeding if a two roll calendar combination is used for rubber profiles, then this equipment is known as :

a) Vacuum – vented extruder

b) Invented "L" calendar

c) Roller – die – extruder

d) Cross head extruder.

iv) The ' reversion characteristics' can be identified by testing the rubber compound in :

a) Mooney Viscometer

b) Rheometer

c) Good rich Flexometer

d) DIN Abrader

v) The major reason for porosity defect in an extrudate profile is :

a) High moisture in filler

b) Low back pressure in extruder head

c) Trapper air & feed cut

d) All the above

d) Draw the Rheograph and indicate IV, MV, ST, MT, O C T & RT (use a graph paper to draw the curve)

(5 + 5 + 4+6)=20

3. a) Explain the mixing of (i) Mastication & (ii) Master batch process of a Natural rubber compound

b) Describe the suitable mixing process of the following :

i) NR compound with 25 phr of HAF + 20 phr of ISAF carbon black

ii) EPDM compound with 250 phr of GPF carbon and 170 phr of paraffinic oil.

c) NR master batch compound of specific gravity 1.115 is mixed in a F-270 Farrel Internal mixer & compound is mixed at a rotor speed of 40 RPM with ram pressure of 6 bar. The dumped batch weight found to be 235 kg. Calculate the fill factor of the batch.

(10 + 4+ 6)=20

4) a) List out with neat sketches the different configuration of calenders used in Rubber Industries.

b) Draw the process flow chart of Z type four roll calendering for both the side coating of nylon tyre cord fabric.

c) Explain the three major gauge control systems used in Z Type four roll calender for achieving uniform gauges.

d) What are the calendering defects observed in rubber industry (list out minimum 05) Expalin any two major calendering defects and its reasons for the same.

(4 + 6 + 6+ 4)=20

GROUP - B

5. a) Write a neat sketch of a hot feed extruder & explain the main parts.

b) Where & why dual tread compound are used ?

c) Write the typical compound formulation of dual tread compound of truck tread.

d) Explain the factors affecting the die swell.

(6 + 2 + 8+ 4)=20

6. a) Explain with a neat sketch the salient features of transfer moulding technique.

b) List the merits and de-merits of transfer moulding process.

c) Write down the formula for calculating the % mould shrinkage.

[Turn Over]

e) Aramide tyre cord

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vi) During moulding operation ' bumping' is performed in curing press:
a) To improve surface finish to the molded product
b) To avoid tackiness to mould
c) To remove entrapped air & vapours during molding
d) To maintain molding pressure

vii) Peripherally drilled roll design is superior than cored roll in 4-roll calender equipment , because :
a) It consumes more water
b) It has slow cooling system
c) T C U not required
d) The surface of the roll temperature can be quickly cooled or enhanced using TCU.

viii) The PRI test is conducted for :
a) Reclaim Rubber
b) De-vulcanized rubber
c) Green strength of SBR
d) Technically specified 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 cure 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 all the General Purpose Rubbers, the ML_{1+4} is normally tested at :
a) 105° C (b) 100 ° C (c) 125 ° C (d) 80° C

xii) To improve the dispersion and to get the extrudate free from porosity it is preferred to use –
a) Dual extruder b) T-head extruder
c) Pin barrel extruder d) Hot feed extruder

xiii) RFL Dipping process is required for processing :
a) Cotton ply tyre cords b) Nylon 6 tyre cords
c) Aramide tyre cords d) Steel tyre cords

xiv) LASE means :
a) Modulus of Rubber compound
b) Loss modulus
c) A cure Index
d) Modulus of N6 tyre cord

xv) ODR means :
a) Open die rheometer
b) Oxidative die resilient
c) Oscillating disc rheometer
d) Ordinary duplex rheometer

xvi) The unit of tensile strength of rubber compound is expressed in :
a) MPa b) Kg / meter
c) Nm d) Ncm

xvii) The 'Marching Modulus' is the rheo property of :
a) SBR based tread compound.
b) Nitrile rubber compound
c) Butyl based tube compound
d) Neoprene based rubber compound

xviii) In a compounded rubber if the free Sulphur migrates from bulk mass to the compond sheet surface, then the phenomenon is called as :
a) Gelling effect
b) Blooming effect
c) Ozone effect
d) Sulphanization

xix) The following molding technique is used for complex moulded article :
a) Compression molding b) Injection molding
c) Blow molding d) None of the above

xx) ML_{1+8} @ 125 ° C is related to :
a) SBR b) IIR c) NBR d) NR

20 x 1 = 20

2 a) Draw the working sketch of ODR & MDR Rheometer used in Rubber Industry.

b) What are the basis of testing at high temperture & low temperature in MDR .

c) What are the data obtained in Mooney Viscometer during Final batch compound testing . Explain?

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c) A NR gum compound is cured in a steel mould at 140° C using a platen type curing press at room temperature of 30° C .
Calculate the % mould shrinkage of the moulded article (if given, co-efficient of Thermal expansion of NR= 216 x 10^{-6}, Steel =11 x 10^{-6}, volume % of rubber and acetone extractable 99%)

(5 + 5 + 4+ 6)=20

7. Following process problems are normally observed in rubber processing. Explain the remedial action to overcome the problem, (answer any **Five**) :

a) An undercure porosity is seen in a thick article of rubber product
b) The batches dumped un-mixed from a Banbury
c) While extruding sidewall compound dimension variation due to excessive die swell.
d) 'Backrinding' problem in a transfer molding.
e) Spot under cure in rubber mat.
f) Porosity in a bladder slug extrusion.
g) Torn edges while extruding a tread (4 x 5=20)

8. Answer any **FOUR** of the following:

a) Steam heating system vs Electrical heating system.
b) Frictioning Process
c) Tangential Internal mixer
d) Drilled Roll vs Cored Roll system
e) Spreading operation
f) Mould Cleaning Process

(4x 5 =20)