INDIAN RUBBER INSTITUTE

PGD-IRI EXAMINATION - 2016

Paper - II

Date: 22.07.2016 **Time: 14.00-17.00 hrs.**

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

Rubber Processing & Engineering

Answers should be illustrated with sketches wherever helpful

Total **FIVE** questions are to be answered. From **Question No. 1** is compulsory.
Answer FOUR from the remaining questions taking TWO from each group.

GROUP – A

1. Choose the correct answer from the given alternatives :

(i) Dispersion during mixing is not caused due to
(a) Improper batch size (b) Insufficient mixing time
(c) Moisture in filler (d) Too high rotor speed

(ii) Shrinkage can be reduced by
(a) Curing at low temperature (b) Reducing the filler content
(c) Avoiding use of transfer/injection molding (d) None of the above

(iii) The amount of die swell in extrusion is dependent upon
(a) Shear rate of extruder and viscosity of compound
(b) Specific gravity of the compound
(c) The tensile test and elongation of the compound
(d) None of the above

(iv) When 3-roll calendar is used for fractioning the surface speed of the bottom roll is usually
(a) Equal to middle roll (b) Slower than middle roll
(c) Faster than middle roll (d) None of the above

(v) Calender rolls are usually made from
(a) Alloy steel (b) Carbon steel (c) Chilled C.I (d) Grey C.I

(vi) Increased friction ratio of the two-roll mill during operating will
(a) Increase temperature of stock (b) Decrease temperature of stock
(c) Increase the stock viscosity (d) Decrease the stock viscosity

(vii) During moulding of a rubber product in press, bumping operation is done to
(a) Improve the surface finish (b) Eliminate the trapped air & vapours from the moulding
(c) Reduce the thickness (d) Obtain total curing

[Turn Over]

(viii) Scorchiness of a rubber compound depends on
(a) Heat history of the compound on the processing
(b) Higher mastication time
(c) Too much plasticizer in compound
(d) Poor dispersion

(ix) Microwave curing is effective for
(a) Non-polar rubber & ingredients (b) Polar rubber & ingredients
(c) Rubber with metal inserts (d) Rubber with mineral fillers

(x) The output rate in an extruder can be significantly improved by
(a) Increased cooling water pressure (b) Increased barrel and head temperature
(c) Increased screw RPM (d) Reduced screw RPM

(xi) Mixing mill operated at smaller nip gap will extert in comparison to larger nip gap a :
(a) Smaller shear force (b) Higher shear force
(c) Identical shear force (d) None of the above

(xii) In the rubber processing terminology the terms like Z-type, Inverse L-type are associated with :
(a) Mixing mills (b) Extruders (c) Compression moulds (d) Calenders

(xiii) Crow's feet is phenomenon associated with
(a) Calendaring operation (b) Spreading operation
(c) Extrusion (d) Continuous vulcanization

(xiv) ML (1+8) @ 125°C is related to :
(a) NR (b) SBR (c) IIR (d) NBR

(xv) Mill Bagging is due to :
(a) Bending of mill rolls (b) Sticking of rubber to rolls
(c) Sagging of rubber & lack of adhesion to rolls (d) Addition of chemicals

(xvi) Air entrapment during extrusion is due to
(a) Excessive choked feeding (b) Pullout conveyor speed problems
(c) Insufficient back pressure at the die head (d) Moisture in the Rubber

(xvii) Blisters in calendared rubber sheet is primarily caused by
(a) High viscosity compound (b) Low viscosity compound / air entrapment
(c) Low calendar roll temperature (d) Even speed feed mill rolls

(xviii) A tight nip on a mixing mill exerts
(a) Lower shear force (b) Higher shear force
(c) Lower temperature build up (d) Does not improve dispersion

(xix) The standard test temperature of the ML_{1+4} Mooney Viscosity is

(a) 150°C (b) 100°C (c) 125°C (d) 141°C

(xx) Banbury rotors are

(a) Cylindrical type (b) Tangential type

(c) Inter-meshing type (d) None of the above

(1 x 20) = 20

2. i) Explain the following :

a) Steaming curing vs. electrical curing

b) Platern heating vs. dome heating system for tyre curing

c) How do you cure thick rubber articles ?

d) Auto clave curing

e) Function of a steam trap

ii) Explain the truck tyre curing process giving example of steam as well as hot water curing system with a model cure cycle.

(5 x 3 + 5) = 20

3. a) A calendar rubber sheet is found to be thicker in the middle than the sides. Suggest reasons for this and how this can be corrected.

b) Discuss with sketches the cooling and heating arrangement in calender rolls for maintaining constant temperature on the roll surface.

c) Discuss briefly the following terms as applied in calendaring operation :

i) Frictioning ii) Topping iii) Sheeting

(8 + 6 + 6) = 20

4. a) What are the advantages and disadvantages of a Moving Die Rheometer (MDR) over an Oscillating Disc Rheometer (ODR).

b) Draw the curve for determination of Mooney scorch in a Mooney viscometer and explain the different terms associated with it.

c) The following carbon black filled NR compound is mixed in a Banbury mixer :

Ingredients	Weight of ingredients (kg)	Bulk volume of ingredients (litres)	Volume after mixing (litres)
NR	100	103	103
N330 Black	50	150	30
Aromatic oil	10	11	11
Zinc Oxide	5	12	1
Stearic acid	3	4	1.5
6 PPD	2	3	1

If the Banbury volume is 270 litres, calculate;

i) Density of the compound in g/cc

ii) Fill factor of the chamber

iii) Percentage of bulk volume to the chamber volume

iv) Percentage reduction of bulk volume after mixing

(5 + 5 + 10) = 20

Group - B

5. a) Draw a sketch of typical internal mixer and highlight the function of each component.
   b) Give a mixing specification for a typical natural rubber based tread cap formulation using highly reinforcing carbon black giving reasons for the sequence of addition of the ingredients.
   c) Calculate the batch weight to be adopted for an Intermix with 710 liters volume and 1.110 compound viscosity with a fill factor of 80%.

(8 + 7 + 5) = 20

6. How are following processing problems can be attempted to resolve
   a) Rough sheeting in calendaring
   b) Blistering in calendared sheet
   c) Uneven dimension in extrusion
   d) Porosity in moulding
   e) Die swell in extrusion

(4 x 5) =20

7. a) What is pressureless vulcanization? State its advantages & disadvantages.
   b) Explain the salient feature of a liquid curing method of vulcanization.
   c) Bring out advantages and disadvantage of microwave curing.
   d) Compare transfer and compression molding with respect to process advantage and disadvantage.

(1 + 3 + 6 + 4 + 6) = 20

8. Write short notes on any four of the following :-
   a) Spreading operation
   b) Steam trap
   c) Reaction Injection Molding (RIM)
   d) Selection of drive system for a mixing mill
   e) Work, Power and Torque

(4 x 5) = 20