

**INDIAN RUBBER INSTITUTE
PGD-IRI EXAMINATION – 2014**

Paper - II

**Date: 11 July, 2014
Duration: 3.00 hours**

**Time: 14.00 - 17.00 hr
Full Marks: 100**

RUBBER PROCESSING AND ENGINEERING

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

Group- A

1. Select the right answer(s) from the given alternatives.

(i) Shrinkage during extrusion operation happens due to

- (a) Insufficient feeding
- (b) Insufficient compound warming up
- (c) Low viscosity of compound
- (d) Excessive pull out

(ii) The terminology of “L-type”, “Inverted L” and “Z-type” are used in describing configuration of

- (a) 2-roll mill
- (b) Cross-head extruder
- (c) 4-roll calendar
- (d) 3-roll batch- off unit

(iii) Calendered sheet thickness is affected by

- (a) Compound viscosity
- (b) Calendar roll profile
- (c) Calendar roll temperature
- (d) All of the above

(iv) Mooney viscometer is a

- (a) Oscillating type with cylindrical rotor
- (b) Oscillating type with bi-conical rotor
- (c) Rotating type with cylindrical rotor
- (d) Rotating type with bi-conical rotor

- (v) In winter season, compound surfaces on storing appears to be grey/white due to:
- (a) Scorch
 - (b) High tack
 - (c) Screw mark
 - (d) Blooming
- (vi) Maximum efficiency in mastication of raw rubber for viscosity reduction is achieved
- (a) At temperature between 95 and 105⁰C
 - (b) At temperature between 110 and 120⁰C
 - (c) Either at temperature below 60⁰C or at temperature above 120⁰C
 - (d) At any temperature
- (vii) Continuous vulcanization of an extruded sponge profile is generally done by
- (a) LCM cure
 - (b) Fludised bed cure
 - (c) Microwave cure
 - (d) Rotocure
- (viii) Cast iron bushes are fixed at the roll journals of 2-roll mill for
- (a) Safety of operator
 - (b) Safety of the rolls
 - (c) Safety of the motor
 - (d) Safety of the electrical panel
- (ix) The main objective of a pin-barrel extruder is to
- (a) Remove porosity of the extrudate
 - (b) Reduce scorch of rubber compound
 - (c) Improve homogenization of rubber compound
 - (d) Reduce die swell of the extrudate
- (x) Torque is defined as product of
- (a) Force and distance
 - (b) Force and area
 - (c) Pressure and distance
 - (d) Pressure and area
- (xi) During calendaring “Crow’s feet “ marks appear on the sheets due to
- (a) High processing temperature
 - (b) Low processing temperature
 - (c) Scorchiness of the compound
 - (d) Softness of the compound

(xii) "Dough" of the rubber compound is used in operation of

- (a) Calendaring
- (b) Extrusion
- (c) Spreading
- (d) Continuous vulcanization

(xiii) A "roller-die" consists of

- (a) A 2-roll calendar in combination with extruder feeding
- (b) A 3-roll calendar in combination with 2-roll mill feeding
- (c) A 2-roll calendar in combination with 2-roll mill feeding
- (d) A 2-roll mill in combination with internal mixer feeding

(xiv) Both side topping is usually done by a

- (a) 2-roll calendar
- (b) 3-roll calendar
- (c) 4-roll calendar
- (d) Spreading machine

(xv) The following physical changes of ingredients occur during mixing cycle

- (a) Entering, contacting, flowing and dumping
- (b) Incorporation, dispersion, distribution and plasticization
- (c) Contacting, squeezing and flowing
- (d) Dispersion, plasticization, squeezing and distribution

(xvi) Microwave heating is effective for

- (a) Polar rubber and ingredients
- (b) Non-polar rubber and ingredients
- (c) Rubber with metal insert
- (d) Rubber with mineral filler

(xvii) In a horizontal single-screw extruder, the pitch of the screw is

- (a) Vertical distance between flight and barrel
- (b) Horizontal distance between two flights
- (c) Horizontal distance between alternative flights
- (d) Angular distance between two flights

(xviii) Excessive remilling of SBR compound may lead to

- (a) Softening
- (b) High tack
- (c) Gelling
- (d) None of the above

(xix) Post cure inflation for tyre is required due to

- (a) Elongation of the carcass fabric
- (b) Thermal expansion of the bead wire
- (c) Improvement of adhesion of rubber to fabric
- (d) Thermal shrinkage during the cooling cycle

(xx) Porosity in fluidized bed curing is avoided by

- (a) Use of desiccant
- (b) Application of pressure
- (c) Use of dried fillers
- (d) All of above

1 x 20 = 20

2. (a) Draw and explain different features of a Mooney curve.

(b) What are the basic differences between ODR and MDR ?

(c) Draw the cure curves obtained from rheometer showing marching modulus, plateau and reversion. Explain the reasons of obtaining such curves.

5 + 6 + (3 x3) = 20

3. (a) Briefly explain the effect of variation of rotor speed, rotor design, ram pressure and dump temperature of quality of mixing in a Banbury.

(b) What are the safety measures to be taken in a 2-roll mixing mill for (i) Machine safety and (ii) Operator safety?

(c) Draw the power consumption curve for an internal mixer and discuss the reasons for the variation of power with time.

8 + 6 + 6 = 20

4. (a) Detail the main constructional features of a screw extruder with neatly drawn sketch.

(b) What are the special features of (i) a vented extruder and (ii) a pin-barrel extruder ?

(c) A rubber cord of specific gravity 1.20 is extruded using 1 cm. die. The rate of extrusion is 200 cms. per minute weighing 250 gms. Calculate the percentage of die swell.

6 + 6 + 8 = 20

Group- B

5. (a) Discuss the following terms as applied in calendaring operation :
(i) Topping, (ii) Frictioning and (iii) Embossing.
(b) Discuss the cooling arrangement in calendar rolls for maintaining constant temperature on the roll surface.
(c) What measures should be taken to avoid the defects like crow's feet and air-blisters in the calendered sheets ?

$$(3 \times 3) + 5 + (3 \times 2) = 20$$

6. What remedial actions should be taken to minimize/overcome the problems of **any five** of the following :
- (a) Poor dispersion of carbon black in compounds mixed in an internal mixer.
 - (b) Excessive die swell of an extrudate.
 - (c) 'Backrinding' problem in a press moulded item.
 - (d) Variation of gauge in calendered sheet.
 - (e) Undercure at the centre of a thick moulded product.
 - (f) Non-uniform temperature in a steam heated vulcaniser.
 - (g) Rough surface of an extrudate.
 - (h) Coat peeling of fabric topping during calendaring.

$$4 \times 5 = 20$$

7. (a) Define Work, Power and Energy.
(b) Name at least three means of power transmission drive as employed in rubber machineries.
(c) Sketch and label a hydraulic circuit for a simple upstroking moulding press.
(d) Compare the steam and electrical heating systems.

$$(3 \times 2) + 3 + 6 + 5 = 20$$

8. Write short notes on **any four** of the following :
- (a) Microwave curing
 - (b) Injection moulding
 - (c) LCM curing
 - (d) Spreading operation
 - (e) Transfer moulding
 - (f) Cold-feed vs. Hot-feed extruders

$$4 \times 5 = 20$$