

INDIAN RUBBER INSTITUTE

DIRI EXAMINATION – 2019

Date : 6th July 2019
Duration : 3 Hours

Paper – II

Time : 14.00 – 17.00 hrs.
Full Marks : 100

Rubber Processing Technology and Process Engineering

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

- I. Choose the correct answer from the given alternatives:
 - (i) Excessive remilling of SBR compound may lead to:
(a) Softening (b) Gelling (c) High tack (d) None of the above
 - (ii) The rate of mastication of synthetic rubbers can be increased by:
(a) using oil (b) antioxidant (c) antiozonant (d) Chemical Plasticizer
 - (iii) “Roller die” consists of combinations of:
(a) A two roll calender with internal mixer feeding
(b) A two roll calender with open mill feeding
(c) A three roll vertical calendar with a two-roll calendar feeding
(d) A two roll calender with extruder feeding
 - (iv) PCI process is associated with the manufacturing of :
(a) Tyre (b) Conveyor belts
(c) Rubber to metal bonded component (d) None of the above
 - (v) On crosslinking the rubber becomes :
(a) Soluble in organic solvents (c) Insoluble in organic solvents
(b) Partially soluble in organic solvents (d) None of the above
 - (vi) Green strength of an uncured rubber compound is the :
(a) Ability to show ozone resistance (c) Lack of tack
(b) Loss of physical properties (d) Ability to maintain stability
 - (vii) RFL dipping on textile fabric is done to :
(a) Improve tensile strength of fabric
(b) Improve tensile strength of rubber compound
(c) Improve adhesion strength between rubber and fabric
(d) Improve flowability of rubber compound

- (viii) Dispersion of fillers is the process of
 (a) Increase of aggregate size (c) Decrease of aggregate size
 (b) Distribution of fillers (d) Fracture of rubber
- (ix) In Hot Feed Extruders, L/D ratio is :
 (a) 2 : 1 (b) 6 : 1 (c) 15 : 1 (d) 20 : 1
- (x) In an Internal Mixer _____ device is used to measure the internal mixing temperature of the compound.
 (a) Thermometer (b) Pyrometer
 (c) Thermocouple wire connected to chamber & indicator (d) None of the above
- (xi) In a tyre manufacturing unit the bead wires are coated with compound using –
 a) Duplex extruder (c) T-head extruder
 b) Triplex extruder (d) Roller Head extruder
- (xii) The batch weight capacity of 28" x 84" mixing mill (if sp. Gravity is considered as 1)
 (a) 56 – 70 kgs. (b) 65 – 85 kgs. (c) 100 – 135 kgs. (d) 80 kgs. Maximum
- (xiii) The term crows feet is associated with :
 (a) Calendering (b) Extrusion (c) Mixing (d) Spreading
- (xiv) On incorporation of carbon black into rubber
 (a) Hardness increases (b) Hardness decreases
 (c) Hardness does not change (d) Becomes brittle
- (xv) Reversion & OCT can be tested by using –
 (a) Mooney viscometer (b) MDR
 (c) Resiliometer (d) DIN abrader
- (xvi) Rotocure curing presses are recommended for curing _____ articles.
 (a) Tyres (b) Tubes (c) Rubberized rollers (d) Conveyor belt
- (xvii) ML_{1+4} @ $125^{\circ}C$ is related to the following polymer
 (a) NR (b) Polyethylene (c) IIR (d) EPDM
- (xviii) After the moulding the O-ring dimensions will measure-
 (a) Lesser than mould dimension (b) Higher than mould dimension
 (c) Equal to mould dimension (d) No effect
- (xix) High temperature & shorter curing time is preferred for
 (a) Thicker moulded articles (c) Thin rubber moulded goods
 (b) Commonly for all NR products (d) None of the above.

- (xx) Mooney viscometer is used to measure the viscosity of
 (a) Cured compound
 (b) Semi cured compound
 (c) Raw polymer, masticated rubber, master batch & final batch Rubber
 (d) Porous compound.

20 x 1 = 20

2.

- (a) Draw a neat sketch of an INTERNAL LMIXER and explain the major parts and its function.
 (b) A Banbury is used for mixing 100 parts NR compound with the rotor rpm of 20 with batch weight of 200 kgs. If the specific gravity of compound is 1.10 calculate the volume of the chamber (assume fill factor as 0.75).
 (c) How do ram pressure and rotor speed affect quality of mixing?

(10 + 5 + 5) = 20

3.

- (a) Define the following common terms used in rubber industry: (i) under cure (ii) over cure (nip gap) (iii) friction ration (iv) splicing (v) delayed action
 (b) Discuss the differences between a rubber extruder and a plastic extruder.
 (c) What are the advantages of pin barrel cold feed extruder over conventional cold feed extruder?
 (d) What is die swell? Explain the factors on which die swell depends.

(5+5+5+5) = 20

4.

- (a) What are the advantages and disadvantages of a Moving Die Rheometer (MDR) over an Oscillating Disc Rheometer (ODR)?
 (b) Draw a typical rheo-curve for reversion-type cure and explain the different terms associated with it. How can you restrict reversion?
 (c) Discuss the working principle of Mooney viscometer and show how Mooney Viscosity and scorch time are determined? State why optimum cure time cannot be found out correctly from this experiment.

(6+6+8)=20

GROUP – B

5.

- (a) Explain the safety factors associated while mixing in a two roll mill with respect to : (i) Machine safety (ii) Human safety
 (b) Discuss the drive system of a two roll mill.
 (c) Show in figures the nip area and the rolling bank of a two roll mixing mill. How it affects the mixing process? Which force is responsible for Front roll to Back roll transfer of the stock? What is up-side down mixing?
 (d) State the functions of different auxiliary chemicals added to the NR latex.

(6+5+5+4)= 20

6.

- (a) Discuss the operations; Incorporation, particle size reduction, distributive mixing and dispersive mixing, during compounding of rubber.
 (c) Name the process and the product for which following equipment/instrument is required
 (i) Ball mill (ii) Braider (iii) Former (iv) Bago-matic press (v) Kneader (vi) Beta scanner

(8 + 2x6) = 20

7. (a) What are the advantages & disadvantages in compression and injection moulding process?
- (b) Explain the method used for vulcanizing the following products:
- (i) Tyre curing
 - (ii) Tube curing
 - (iii) Hand gloves
 - (iv) O-ring
 - (v) Rubber band
 - (vi) Ballons
 - (vii) Steel cord conveyor belt
- (c) State the probable reasons for the following processing problems:
- (i) Air entrapment
 - (ii) Blister
 - (iii) Crows feet defect
 - (iv) Tearing
 - (v) Blooming
 - (vi) Flow cracks
 - (vii) Sticking to moulds.

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

(6 +7 +7) = 20

- (i) Roto-cure
- (ii) Temperature control system in Banbury mixer
- (iii) Roll Bending and Roll Cambering
- (iv) Cold feed extruder
- (v) Mould shrinkage
- (vi) Mastication

4 x 5 = 20