INDIAN RUBBER INSTITUTE

PGD-IRI EXAMINATION – 2010

Paper – II

Date : 29th June, 2010 **Time: 14.00 – 17.00 hrs.**
Duration : 3 Hours **Full Marks: 100**

Rubber Processing & 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

1. Select the right answer from the given alternatives:

(i) Measurement of the inside temperature of an extrudate is carried out using:
(a) A mercury thermometer
(b) A thermocouple
(c) A needle pyrometer
(d) Non contact pyrometer

(ii) Shrinkage during extrusion operations can be due to
(a) Excessive pull out
(b) Insufficient feeding
(c) Excessive choked feeding
(d) Insufficient stock warming up

(iii) Air extrapment 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

(iv) Blisters in a calendered 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

(v) The terminology "L-Type", "Inverted L" and "Z-Type" are used for describing configuration in
(a) 4-roll calenders
(b) 2-roll mill
(c) 3-roll batch-off unit
(d) None of the above

(vi) The calendered sheet gauge is influenced by
(a) The calendar roll profile
(b) Compound viscosity
(c) Calender roll temperature
(d) All of the above

(vii) Friction ratio of the warming up mills influences
(a) Warming up time
(b) Temperature build up of the stock
(c) Compound viscosity
(d) All of the above

(viii) 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

(ix) Post cure inflation for truck tyres is required due to
(a) Elongation of the carcass fabric
(b) Thermal shrinkage during the cooling cycle
(c) Thermal expansion of the steel
(d) Improve the adhesion of the fabric to rubber

(x) The standard test temperature of the ML_{1+4} Mooney Viscosity is
(a) 150 ^{0}C (b) 100 ^{0}C (c) 125 ^{0}C (d) 141 ^{0}C

(xi) Strees -strain properties of a rubber compound is evaluated on a
(a) Abrasion Tester
(b) Chip and chunk tester
(c) Universal Tensile tester
(d) Mooney viscometer

(xii) The Oscillating Die Rheometer employs a
(a) 1" Rotor
(b) Rotating spindle
(c) Oscillating Die
(d) Parallel plates

(xiii) Mooney Viscometer is a
(a) Oscillating type Viscometer with Bi-conical Rotors
(b) Oscillating type Viscometer with Cylindrical Rotors
(c) Rotating type Viscometer with Bi-conical Rotors
(d) Rotating type Viscometer with Cylindrical Rotors

(xiv) Banbury rotors are
(a) Cylindrical type
(b) Tangential type
(c) Inter-meshing type
(d) None of the above

(xv) "Bagging" in 2-Roll Mill can be minimized by
(a) Increasing nip gap
(b) Decreasing nip gap
(c) Cooling both rolls
(d) None of the above

(xvi) Calender machine roll are made of
(a) Cast Iron
(b) Cast Steel
(c) Chilled Cast Iron
(d) Alloy Steel

(xvii) In a Cold Feed Extruder the L/D ratio generally is
(a) 5 : 1
(b) 10 : 1
(c) 15 to 20 : 1
(d) 25 to 30 : 1

(xviii) "Crow's feet" is a phenomenon connected with
(a) Calendering operation
(b) Spreading operation
(c) Extrusion
(d) Continuous curing

(xix) In moulding process "Bumping' is used to
(a) Remove entrapped air
(b) Facilitate flow of rubber compound
(c) Fill mould cavity uniformly
(d) Reduce curing time

(xx) Maximum efficiency in mastication of crude rubber for viscosity reduction is obtained
(a) At temperature between 95 to 105^0C
(b) At temperature between 110 to 120^0C
(c) Either at temperature below 60^0C or at temperature above 120^0C
(d) None of the above.

1 x 20 = 20

2. (a) Draw a sketch of a 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 litres volume and 1.110 compound viscosity with a fill factor of 80%.

(8+7+5) = 20

3. (a) Compare and contrast Mooney Viscometer & Oscillating Disc Rheometer with respect to their construction & design features using suitable sketches.
(b) What are the advantages & disadvantages of Oscillating Disc Rheometer over Mooney Viscometer?
(c) What is meant by ML_{1+4} @ 100^0C and for what purpose it is used?

(10+6+4) = 20

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

(4 x 5) = 20

Group – B

5. (a) Draw neat sketches of the possible configurations of a 4-roll calender set up.
(b) What are the modern systems adopted for measuring and ensuring uniformity of gauge?
(c) How is cooling of the calendered sheets achieved? Illustrate your answer with a sketch.
(d) List out the possible defects commonly associated with calendering.

(7+5+4+4)=20

6. (a) Highlight the advantages and disadvantages of rubber moulding in a hydraulic press using electrical heating vis-a-vis steam heating.
(b) Discuss the advantages and disadvantages of steam heating compared to hot air heating in an autoclave vulcaniser.

(10+10)=20

7. (a) Calculate the line pressure to be used in rubber compression moulding using a Hydraulic Press having Ram Diameter of 30 cm for a mould with dimension 30 cm for mould with dimension 35 cm (L) x 20 cm (B) and specific pressure of 46 Kg. per sq. cm. of mould area.
(b) What is the batch weight of a compound of specific gravity 1.20 being mixed in a Banbury having capacity of 250 litres using a fill factor of 0.80.
(c) Discuss the different types of cooling arrangement available for calendar rolls.
(d) Compare and contrast between hot feed and cold feed extruders.

(4 x 5) = 20

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

(a) Laboratory abrasion testing
(b) Pin barrel extruder
(c) Mastication of natural rubber
(d) Injection moulding of rubber
(e) Mill safety systems
(f) Hysteresis properties of rubber compounds

(4 x 5) = 20