INDIAN RUBBER INSTITUTE

DIRI EXAMINATION – 2015

Paper-II

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

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

Rubber Processing Technology & Process Engineering

Answers should be illustrated with sketches wherever helpful

Total **FIVE** questions are to be answered. From **"Group-A"** answer **three** questions out of which **Question No. 1** is compulsory and from **"Group-B"** answer **two** questions only.

GROUP – A

Q.1. Multiple choice questions: Select the correct answer from the given alternatives: 20x1=20

(i) Mastication of rubber is the process of:

(a) Cutting the bales in smaller pieces

(b) Sheeting out the rubber

(c) Reducing the viscosity of the rubber

(d) Extruding the rubber through a die

(ii) Cambering of calendar rolls are done to

(a) Increase the life of the calendar rolls

(b) To bring smoothness on the surface of the calendered sheet

(c) To maintain uniform gauge of the calendered sheet

(d) To reduce thickness of the calendered sheet

(iii) Calender rolls are usually made of:

(a) Alloy steel (b) Carbon steel

(c) Chilled cast iron (d) Grey cast iron

(iv) Mastication efficiency of NR on the mixing mill is lowest in the temperature range ;

(a) 25 – 55°C (b) 60 – 95°C (c) 100 – 120°C (d) 130 – 140°C

(v) In a Hot Feed extruder, L/D is : (a) 2:1 (b) 6:1 (c) 15:1 (d) 20:1

(vi) "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 calender with a two-roll calender feeding

(d) a two – roll calender with extruder feeding

(vii) If the fill factor of F -270 Internal mixer is 0.75, then batch weight of compound is :-

(if the Sp.Gravity is considered as 1)

(a) 20.2 kg. (b) 202 kg (c) 270 kg (d) 175 kg

[Turn Over]

(viii) Mooney Viscometry is the most effective test for predicting the behavior of rubber compounds during;
(a) Casting (b) Reaction injection molding (c) Compression molding (d) Injection molding

(ix) Time t_2 from Rheometer curve is related to –
(a) Process safety during calendering
(b) Process.safety during extrusion
(c) Mould flow time
(d) Time required for mixing.

(x) The reason for blisters appearing on the calendered surface, may be due to;
(a) Degradation (b) Higher temperature (c) Lower temperature (d) None

(xi) Preservative for NR latex used commonly is ;
(a) Ammonia solution (b) Acetic acid solution
(c) Formic acid solution (d) KOH solution

(xii) 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.

(xiii) Typical mill friction ratio for NR compound :
(a) 1:1 (b) 1:1.20 (c) 1:2.0 (d) 1:5

(xiv) The unit of pressure is
(a) Newton (b) Pascal
(c) Joule (d) Watt

(xv) To convert lbs/ sq. in to Kg/cm^2 multiply by
(a) 0.10 (b) 0.01
(c) 0.07 (d) 0.09

(xvi) To test the Mooney viscosity of IIR compound at 100°C the pre-heat time required is:
(a) Four minutes (b) Three minutes (c) Eight minutes (d) One minute

(xvii) Volume x Specific gravity x Fill factor is equal to –
(a) Bulk volume rate (b) Batch weight
(c) Volume liter (d) Bulk viscosity.

(xviii) In a hydraulic curing _____ process needs to be done to remove entrapped air of a rubber product
(a) Frictioning (b) Prickling (c) Awling (d) Bumping

(xix) PCI process is associated with the manufacturing of .

(a) Tyre (b) Conveyor belt

(c) Rubber to metal bonded component (d) None of the above

(xx) In tire manufacturing process bead wires are coated with rubber compounds, using:

(a) Duplex extruder (b) T head extruder (c) Triplex extruder (d) Roller head extruder.

Q.2. (a) Draw a Torque vs Time curve as obtained from the Oscillating Disc Rheometer. Show the different parameters obtained from it, such as T_i, M_L, M_H, T_2, T_{90}, marching modulus, plateau effect and reversion. Calculate the cure rate index and reversion rate. 2+4=6

(b) Synthetic rubbers are usually mixed on the mixing mill at roll temperatures warmer than that used for Natural Rubber. Explain. 2

(c) Calculate the specific gravity of the stock prepared with the following recipe

	Phr	**Sp. gr**
Natural Rubber	80	0.92
Butadiene Rubber	20	0.94
ZnO	5	5.57
Stearic acid	2	0.85
Antioxidant	1	1.10
HAF Black	40	1.80
Aromatic oil	7	1.27
CBS	1.0	1.40
TMTD	1.0	2.07
S	2.5	1.90

5

(d) 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? 4+3=7

Q.3.(a) Differentiate between hot feed and cold feed extruders? Show with proper diagram different parts of extruder. How do you extrude the tread part of a tyre? 2+6+2=10

(b) When is pin and barrel extruder used? What is die swell? Name two problems encountered in extrusion and their rectification? 2+2+2=6

(c) Differentiate between T-head and dual head extruder. 4

Q.4 (a) Sketch different types of calendar machine and discuss what for they are used.

(b) How friction ratio & temperature of a calendar machine are controlled.

(c) Name a few defects encountered during calendaring & their rectification.

(d) Differentiate between frictioning and topping 6+5+6+3 = 20

GROUP – B

Q.5.(a) Why compounding ingredients are added to the latex in the form of dispersions or emulsions? Discuss how the dispersions and emulsions are prepared? 1+6 = 7

(b) How prevulcanized latex is prepared? Discuss the procedure with a typical formulation. 5

(c) Why bumping is done during compression molding? 2

(d) What is the minimum pressure required for compression molding of rubber? 1

(e) Why the temperature of vulcanization of rubber is kept between 140°C to 160°C during press cure? 3

(f) What is the limitation of spreading operation? 2

Q.6. (a) State the difference between a Ram and a Screw injection molding machine with neat sketch. 5

(b) If a circular article is extruded in a cold feed extruder at 85°C of extrusion temperature, which attains the final dia of 10 mm at the time of booking, calculate the % die swell if the dia of original die is 8 mm. 5

(c) Compare the advantages of "Peripherally drilled rolls" vs. cored rolls with neat sketch of a calendaring process. 5

(d) Write down two major disadvantages in transfer molding. 5

Q.7. (a) What are the safety measures shall be followed in a mixing mill :-

(i) Equipment safety (ii) Operator safety. 6

(b) 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? 6

(c) Name the process and the product for which following equipment/instrument is required:

(i) Ball mill (ii) Bag-o-matic press (iii) Autoclave (iv) Beta-scanner 4x2=8

Q.8. Write short notes on any **four**.

(a) Roto-cure

(b) Roll bending and Roll cambering

(c) Microwave curing

(d) Upside down mixing of EPDM rubber

(e) Steam heating vs. Electrical heating system.

(f) Mold Shrinkage 4×5 =20