## INDIAN RUBBER INSTITUTE
## DIRI EXAMINATION – 2014

Paper – II

Date: 11 July, 2014                    Time: 14.00 – 17.00 hrs.
Duration: 3 Hours                      Full Marks: 100

### Rubber Processing Technology and 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

1. Choose the correct answer from the given alternatives

   i)    Calender rolls are usually made of :
         a) Alloy steel        b) Carbon steel
         c) Chilled cast iron   d) Grey cast iron

   ii)   A common and often overlooked cause of poor dispersion is :
         a) Specific gravity of stock is too low    b) Batch size too large
         c) Dump temperature too low                d) None of the above

   iii)  In Mooney Viscometer the rotors are designed as L and S, which stands for:
         a) Long and short    b) Low and slow
         c) Large and small   d) None of the above

   iv)   PCI process is associated with the manufacturing of:
         a) Tyre                              b) Conveyor belt
         c) Rubber to metal bonded component  d) None of the above

   vi)   Wallace Rapid Plasticity Number illustrates about :
         a) Scorch time                                b) Cure time
         c) Sagging of rubber & lack of adhesion to rolls   d) Addition of chemicals

   vii)  Screw mark is associated with :
         a) Calendering    b) Open steam cure    c) Extrusion   d) Press moulding

   viii) Scorching of rubber compounds takes place due to:
         a) Excessive oil dosage              b) Slow curing accelerators
         c) Excessive processing temperature  d) Improper black dispersion

   ix)   The fill factor in a Banbury mixer for curative mixing is :
         a) 50 - 55     b)   60 - 65     c)    70 - 75     d) 80 - 85

x)  Excessive remilling of SBR compound may lead to:
    a) Softening    b) Gelling  c) High tack    d)   None of the above

xi)  Torque is defined as a product of:
    a) Multiplying force and distance
    b) Multiplying pressure and area
    c) Multiplying area and distance
    d) Multiplying force and pressure

xii)  For better dispersion in a two roll mill mixing:
    a) Bank size should be large
    b) Bank size should be small
    c) Roll cooling should be enough
    d) Bank size should be such that material rolls constantly at the nip

xiii)  Microwave heating system is effective for:
    a) Peroxide crosslinked NR
    b) Rubber with metal inserts
    c) Polar rubbers and ingredients
    d) Non polar rubbers and ingredients

xiv)  Green strength of an uncured rubber compound is the:
    a) Ability to show ozone resistance
    b) Lack of tack
    c) Loss of physical properties
    d) Ability to maintain stability

xv)  Silicone emulsions are used as :
    a) Mould release agent
    b) Reinforcing agent in silica filled compound
    c) Emulsifying agent in emulsion polymerisation
    d) None of the above

xvi)  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

xvii)  Spider is fixed in the die box of an extruder for production of :
    a) Tyre tread
    b) Tube
    c) Window channel
    d) Outer cover of hose

xviii) Premastication of rubber is the process of
    a) Cutting the bales in smaller pieces
    b) Sheeting out the rubber
    c) Reducing the chain length
    d) Extruding the rubber through a die

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xix) In Hot Feed Extruders, L/D ratio is:
a) 2 : 1
b) 6 : 1
c) 15 : 1
d) 20 : 1

xx) The term dough is associated with :
a) Calendering
b) Extrusion
c) Mixing
d) Spreading

(1x20) = 20

2.   a)   Calculate the specific gravity of the following compound

| Material | Part by weight | Specific gravity |
| --- | --- | --- |
| NR | 100.00 | 0.94 |
| Peptiser | 0.10 | 1.80 |
| Carbon black | 50.00 | 1.80 |
| Process oil | 10.00 | 1.02 |
| Zinc Oxide | 5.00 | 5.57 |
| Stearic Acid | 2.50 | 0.85 |
| Antioxidant | 1.00 | 1.10 |
| Soluble sulfur | 2.50 | 2.00 |
| Accelerator MOR | 1.00 | 1.30 |

b)   What is the sequence of mixing of the above compound?
c)   Explain upside down mixing.
d)   Calculate the batch weight in kg of a 270 liter Banbury mixer having fill factor 75% for a rubber compound having density 1.1 g / cc.

(6+5+5+4)= 20

3.   a)   Sketch a typical rubber extruder showing its different parts.
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.

(6+5+4+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 curve for a rheometer and explain the different terms associated with it.
c) What is Initial Plasticity Number and Plasticity Retention Index? Explain the significance of both terms in rubber industry.
d) Sketch and explain a Mooney curve.

(5+5+5+5) = 20

## GROUP-B

5. a) Explain the safety factors associated when mixing in a two roll mill mixing with respect to ;
    i)    Machine safety
    ii)   Human safety
   b) Define the following terms;
    i)    Work
    ii)   Power
    iii)  Energy
    iv)   Efficiency

   c) Draw a power consumption – time curve for an internal mixer and discuss the reasons for variation of power with time
   d) Discuss the drive system of a two roll mill

$$(6+4+5+5)= 20$$

6. a) Sketch and explain various roll arrangements of calendars.
   b) Explain the various methods to be adopted for obtaining uniform thickness in calendering.
   c) Explain spreading operation with a diagram.
   d) Explain the reasons for scorching and stock blister in calendering.

$$(5+6+5+4) = 20$$

7. a) Explain Platen heating versus dome heating system for tyre curing.
   b) Explain the salient feature of a liquid curing method of vulcanization.
   c) Give the significance of use of pressure gauges in compression moulding.
   d) What is dryness factor of steam? Explain what will be the effect on the vulcanisate if the steam used in curing remains wet.

$$(6+5+4+5)=20$$

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

    i)    Rotocuring
    ii)   Temperature control system in Banbury mixer
    iii)  Ram and screw extruder
    iv)   Steam versus electrical heating
    v)    Steam trap
    vi)   Mastication

$$(4x5)=20$$