

**DETAILED SYLLABUS FOR THE POST OF ASSISTANT
DIRECTOR(PLASTIC)
(Industries and Commerce) - Direct Recruitment**

(CAT.NO.: 386/2021)

Module I : Polymer Science & Speciality Polymers (20 Marks)

History and Classification of Polymers: History of polymers – special characteristics and general applications of polymers – elastomers, plastics, fibres, surface coatings and adhesives. Science of micro and macro molecules, definition of monomer, oligomer, polymer, macromolecules and micro molecules with examples of each.

Degree of polymerization (D P), relationship between DP and MW, worked out examples, Classification of polymers – Natural, synthetic and derived, thermoplastics, thermos sets, crystalline and amorphous, organic and inorganic, homo chain and hetero chain. Homo and co-polymers; linear branched and cross linked; block and graft copolymers, alternating and random copolymers.

Stereo regularity of polymers – optical and geometrical isomerism with reference to isoprene, butadiene and chloroprene, isotactic, syndiotactic and atactic configuration with reference to polypropylene, effect of stereo regularities on properties.

Functionality and Polymer Formation: Definition of functionality – mono, di and poly functional monomers with examples, Effect of unsaturation in functionality of monomers like ethylene, styrene, acrylonitrile and acetylene. Functionality of phenol, dicarboxylic acid, diamine and diol. Average functionality principle of polymerisation.

Polymerisation Reaction and Techniques: Types of polymerization reaction – chain and step polymers with examples – steps in chain polymerisation – initiation, propagation and termination. Mechanism of free radical, ionic and co-ordination polymerization. Living polymer, initiators catalyst, inhibitors and chain transfer agents with examples. Step growth polymerization, ring scission polymerization and interfacial polymerisation with examples. Polymerisation techniques - bulk solution, suspension and emulsion polymerization. Role of ZN catalyst.

Reaction of polymers: Difference between reaction of polymers and simple molecules. Behaviour of functional groups in polymers, reactions like hydrolysis, acidolysis, aminolysis, addition substitution, reaction of groups like hydroxyl, aldehyde, ketone, carboxylic and cyclisation reaction.

Molecular Weight and its Determination: M_w , M_n – their derivation. Z-average molecular weight, simple problems on DP and molecular weight. Polydispersity and MWD of polymers and its significance. Experimental determination of MW and MWD – end group analysis vapour phase osmometry light scattering, viscometry and GPC – their principles.

State of Phase and Aggregates of Polymers: Glass transition temperature, melt temperature and flow temperature – methods of determination. Crystallinity, crystallisability, determination by X-ray diffraction method. Amorphous and crystalline nature of plastic, elastomers and fibres.

Identification of Polymers: Purpose of identification – Physical and chemical methods.

Thermal analysis – TGA, DSC and DTA.

Spectroscopy, NMR and IR.

Polymer Degradation: Types of degradation – chain and random – examples. Thermal, mechanical, high energy radiation, oxidative degradation. Ozone degradation. Advantages and disadvantages of degradation. Factors affecting thermal stability – polymer stabilization. Various additives – antioxidant, antiozonant and light stabilizers. Mechanism of stabilization. Methods to study polymer degradation – TGA, DSC, DTA and IR.

Polymer Modifications: Physical and chemical methods of polymer modifications. Physical methods – blends, alloys and composites.

Chemical methods – co-polymerisation, grafting, crosslinking and interpenetrating networks.

Speciality Polymers: High temperature and fire resistant polymers – polymers for high temperature resistance – Fluoropolymers. Aromatic polymers, Polyphenylene sulphide, polysulphones, polyesters, polyamides, polyketones, Heterocyclic polymers. Polymers with electrical and electronic properties. Conducting polymers. Conducting mechanisms, polyacetylene, polyparaphenylene, polypyrrole, organometallic polymers, photo conducting polymers, polymers in non-linear optics, polymers with piezoelectric and pyroelectric properties, photoresists for semiconductor fabrication – liquid crystalline polymers.

Ionic polymers, synthesis, physical properties and applications, Ion-exchange, Hydrophilicity, Ionomers based on polyethylene, elastomeric ionomers. Ionomers based on polystyrene, ionomers based on PTFE, ionomers with polyaromatic backbones, polyelectrolytes for ion exchange, polyelectrolytes based on carboxylates.

Polymer concrete, polymer impregnated concrete ultra high modulus fibres, polymers for biomedical applications, polymeric binders for rocket propellants, polymer supported reagents. Optical fibre telecommunication cables.

Module II: Rubber Technology (Natural and Synthetic Rubber) (20 marks)

History & Development of Natural Rubber: As an important industrial raw material – major sources – propagation of *Hevea brasiliensis*, different clones, extraction of Latex – methods of extraction of latex – tapping, standard of tappability for seedling and budded trees. Tapping knives, tapping task, tapping rest. Different systems and their intensity, intensive tapping, ladder tapping, slaughter & puncture tapping. Factors affecting tapping efficiency. Rain guarding, yield stimulation.

Preservation and Concentration of NR latex: Definition of Latex – composition and function of non-rubber constituents, colloidal nature of latex, micro-organisms in latex and their role in destabilization, need for preservation of latex, short and long term preservation – NH_3 as ideal preservative, secondary preservatives – LATZ type, pre-coagulation and use of anticoagulants – examples. Coagulation and methods of coagulation of Latex

Concentration of Latex: Need for concentration of Latex – Latex concentration methods – creaming, centrifuging, evaporation and electro decantation.

Marketable Forms of Dry Rubber: R.S.S., crepe block rubber – processing of field latex into R.S.S., ADS, different grades, current market status, and future prospects. Production requirements – Green book.

Crepe Rubbers: Different grades and their processing. Application of each grades, current market status and future prospects. Production requirements.

ISNR: Different grades, manufacturing details, production requirements, quality enhancement, current status and future prospects.

Speciality Rubbers: Importance of speciality rubbers in rubber industry – features, production methods, chemical aspects, applications and current status of the following speciality rubbers – SP rubber, CV and LV rubber. OENR, tyre rubber, powdered natural rubber, Hevea plus MG, DPNR, Latex black master batch, epoxidised NR, cyclised NR, chlorinated NR.

Reclaim Rubber: Reclaim rubber – definition, objectives of reclaiming – raw materials for reclaim production – reclaiming agents and their specific functions – Manufacturing of reclaim by various methods – comparison of different processes – types of reclaim rubber and their specifications, processing advantages of reclaim rubber – applications.

Brief History of SR - Classification: Rubber elasticity & characteristics of elastomers Monomers – Preparation and properties of the monomers – styrene, butadiene, isoprene, Isobutylene, ethylene, propylene – structure of Diene monomers – ethylidene 2 Norbornene, (ENB) Dicyclopentadiene (DCPD), 1, 4, Hexadiene used in Ethylene propylene Rubbers – Detailed study of SBR, PBD, IR, EPDM, & IIR.

Special Purpose - SR: Detailed study of – NBR, CR, CSM, PU, Polysulphide & Silicone Rubbers.

Study of – fluoro carbon rubbers, Acrylic Rubbers & Epichorohydrin rubbers, polypropylene rubbers.

Ethylene – Acylic rubbers, chlorinated polyethylene rubbers, carboxylated SBR, NBR, Butadiene hydroxyl terminated SBR, NBR, Butadiene – Halobutyl rubbers

Thermo Plastic Elastomers: Thermo plastic elastomers, definition, advantages, modification of elastomers to thermoplastic elastomers. Study of thermoplastic SBR, Ethylene, Vinyl acetate, Thermo polyurethane.

Blends: Definitions – Advantages, procedure, blending for specific properties, study of NR, PBD, NR-SBR-PBD, NR-EVA, NBR-PVC, NR-HSR.

Principles of Compounding: Rubber compounding – definition and objectives formulation of recipe and its significance – role of recipe in rubber product manufacturing – Method of representing the relative proportions of ingredients in a recipe (PHR) – importance of compounding.

Compounding Ingredients and their Classification: Different class of compounding ingredients, base polymer, curing system, vulcanizing agents, accelerators, activators and their function in a compound – the role of other ingredients like filler, plasticizers, softener and other special additives in a recipe, selection procedure of ingredients – Compatibility and solubility parameter concept.

Theory of Vulcanization: Vulcanization - Changes in elastomers due to vulcanization, Sulphur vulcanization – theory of sulphur vulcanization – Different types of cross links formed and their effect on vulcanisate properties.

Classification of Vulcanization System: Low sulphur vulcanization system – C.V, E. V and S.E.V system – comparison – Non-sulphur vulcanization system – sulphur chloride – organic peroxide – metal oxides – resin – dioxime – isocyanates etc with example. Curing system for olefin and non olefin rubbers.

Preparation, Properties & Application of Compounding Ingredients: Fillers – definition and objectives – classification of fillers – Non-black fillers preparation, properties and application of non black fillers such as silica, silicates, clays, whiting, lithopone, barites, talc, zinc oxide, MgO, TiO₂.

Fibrous fillers: Asbestos, cellulose fiber, flocks, wood flour, organic fillers – cork, glue, cyclised NR, hevea-plus, HSR, phenolic resin.

Carbon Black: Different grades and method of manufacture – furnace process – thermal process channel process – lamp black process – Different grades – SAF, ISAF, HAF, FEF, GPF, SRF, MT, conducting black – etc. ASTM D 1765, colour coding and international reference black – properties of carbon black – particle size, structure - physical nature of particle size, chemical nature of particle size, particle porosity – determination of particle size and structure – application of carbon black.

Antioxidants and Antiozonents: Functions, types staining and non-staining. Mechanism of degradation – factors affecting degradation. Retarders – functions.

Plasticizers: Softeners and extenders – Plasticizer function – classification of plasticizers.

Special Purpose Ingredients: Blowing agents, flame retardants, abrasives, antistatic agents, integral bonding additives, stiffening agents coupling agents, deodorants etc.

Cure characteristics & Measurements: Define cure time – cure index, vulcanization time, scorch and scorch time, heat history of compounds, optimum cure, state of cure, methods to avoid scorch reversion cure, marching cure and plateau.

Define over cure and under cure, illustrate with cure graph – discuss the various cure graphs by changing the compounding ingredients such as accelerator, vulcanizing agents – determination of viscosity using Mooney viscometer.

Rheometers: MDR, ODR – determination of cure characteristics using Rheometers.

Assessment of State of Cure: Define rate of cure – cross-link density – practical assessment of state of cure. Calculation of cure in thick articles.

Vulcanization methods: Brief introduction of processing methods for product manufacture – flow chart.

Compounding for Vulcanizate Properties: General principles of compounding vulcanization properties. Comparison of raw elastomeric properties factors to be considered for designing a rubber compound with examples – Effect of particle size and structure of fillers on processing and vulcanizate properties – compounding to meet processing requirement viscosity control, control of nerve, adhesion to mill rolls, tack, scorch, calendering and extrusion – continuous vulcanization.

Calculation of Specific Gravity and Volume Costs: With worked out examples.

Compounding for Vulcanizate Properties: Such as hardness and modulus with worked out examples. Tensile properties, T.S. elasticity etc. – Resistance to abrasion and tear – resistance to cyclic stressing – flex cracking – cut growth and fatigue – low temp flexibility – electrical properties – resistance to gas permeation – bonding to non-rubber substrate like metals. Stabilizing agents – stabilization against – heat, flame, liquids, light, oxygen ozone, atmospheric exposure.

Module III: Rubber Products (20 Marks)

Moulded Products: Compound design – Automobile bushes – Door mats – Tea-mats, Paperweights, IB caps, Door bushes, Nipples, Hot water bags, Chemistry of hard rubber products (Ebonite). Method of production and compound design for battery boxes – Finishing of rubber mouldings.

Expanded Products: Types of blowing agent and their comparison – compounding and moulding of cellular rubber products, MC, Hawaii sponge.

Extruded Products: Automobile treads, channels, inner tubes, LPG tubes etc – compound design, typical formulations, Methods of manufacture.

Calendered Products: Supported and unsupported sheeting, Hospital sheeting, Profile calendered products – design criteria, compound design, typical formulations.

Footweares: Components of footwear, materials, methods of manufacture, special purpose footwear and their applications.

Miscellaneous Products: Oil seal, Gaskets – Compound design, Manufacture and Typical formulations.

Sports Goods: Play ball, Tennis balls, Golf balls – components, compound design, method of manufacture, typical formulations.

Rubber to Metal Bonded Products: Principle of bonding rubber to metal and textile fibers, production of rubber covered rolls – metal preparation – compound preparation, assembling curing, finishing – tank lining – production method, compounding, compound design. Production of typewriter rolls, rice polisher, textile roller.

Rubber Coated Textile: Rexene, Tarpaulin and other rubber coated textile, rubber lining, spreading, design principles of spreading, compounding and typical formulations. Adhesive treatment for Nylon 6, Nylon 66, Polyester-adhesive composition and their preparations.

Beltings: Conveyor belts, Transmission and V-belts, components manufacturing techniques, Batch and continuous curing, compounding, typical formulations, specification tests for V-Belts.

Hoses: Classification according to manufacture and end use. Components. Moulded hose, Mandrel cured hose, braided hose, Knit hose, Woven hose, Spiral reinforced hose, Circular woven hose, Handmade hose, Radiator hose, Garden hose, Petrol hose, Sand blasting hose, Typical formulations, method of manufacture.

Cables: Classification, power cables and their components, manufacturing methods, curing, compound design, typical formulations, specification tests.

Latex Products

Dipped Goods: Introduction to various dipped goods – dipping processes. Methods of dipping – straight dipping, coagulant dipping, dipping with porous mould dipping with heated formers – merits and demerits of each – relation between thickness of deposits and number of dips in each case – after treatments of latex deposits – drying, surface treatment, bleaching, chlorination, vulcanization and stripping- compounding of latex for manufacture of various types of dipped goods and some typical dipping compounds. Manufacture of important dipped goods like gloves, balloons, nipples, rubber bands and condoms etc. some common defects and their remedies – examination gloves – methods of manufacture, machinery, powder free dusting, recent developments.

Production by Casting: General principle, process of casting – production of hollow and solid articles by casting – preparation of moulds for latex casting, products by casting technic.

Latex Foams: Foam manufacturing industry in India – introduction to various latex foam products, manufacture of latex foam – Dunlop and Tallalay process, different steps – deammoniation, compounding, mechanical frothing, gelling, vulcanization etc.

Gelling – various gelling system – a comparative study. Some typical latex compounds for foam production. Common defects and causes.

Fibre Foam (Latex Treated Coir) and Carpet Backing: Characterization of fibre foam – constituents, production of coir foam – various steps – advantages of carpet backing. Methods of applying latex to carpet backs, carpet backing formulation.

Latex Extrusion: General principles of latex extrusion – important latex products made by extrusion. Manufacture of latex thread – details of processes and equipments, quality control tests for latex thread comparison of latex thread with dry rubber thread. Applications of latex thread, latex rubber tubing details of processes and equipments, application of rubber tubing. Common defects and causes.

Latex Adhesives: Introduction – comparison with solvent based adhesives compounding of latex for the preparation of adhesives, types of adhesives – paper and leather adhesives – method of preparation and their characteristics – Adhesives for metals, ceramics and glass. Rubber to textile bonding adhesives – nature of adhesives and typical formulation of RFL adhesives – adhesives for treatment of tyre cord – composition and properties.

Latex Impregnation & Spreading: General principles, differences, fabric proofing coating, advantages of spreading, machinery for spreading, compound for sheet, catheters.

TYRE AND TUBES

Introduction: History on the design and development of tyres – a survey of tyre manufacturing industries – consumption pattern – statistics – in India and abroad.

Automobile tyres: Introduction – pneumatic tyre and its functions – Basic tyre construction – tyre sizing – aspect ration and its significance – General system for indicating tyre dimensions – different tyre components of a tyre, its geometry – functions.

Raw Materials used for Tyre Manufacturing: Tyre cords – reinforcing materials – their advantages and disadvantages – compounding ingredients.

Production of Tyre Components: Compounds formulation and production of different component of tyre – tread, side wall, bead unit, chafer, flipper, clinch strip, inner liner – production carcass plies – pre-treatment of tyre cords fabric processing, calendaring, bias cutting into plies.

Tyre Building: Both bias and radial tyres building – building of green tyres for bias, bias belted and radial tyres – green tyre treatment – tyre curing methods – curing bags, bladder, diaphragms – auto form press, BOM press, PCI – advantages of PCI – typical formulation for curing bags – brief idea of tubeless tyre.

Automobile inner tubes: Function – different steps involved in the production of inner tubes – compounding formulation – tube curing – inspection and packaging.

PRODUCTION OF TWO WHEELER AND AUTO TYRES

Solid Tyre: Comparison with pneumatic tyre – advantages and disadvantages.

Re-treading Materials: Introduction – necessity and importance of re-treading – Pre-operations – conventional and pre-cured tread. Different sizes of tread – dimensions – re-treading process – hot and cold – machinery used for re-treading typical compounds for tread in hot and cold process.

Cycle tyre and tubes: Cycle tyre components and their production – cycle tyre building – collapsible drum method and mono band method – curing of cycle tyre – BOM presses – cycle tube – methods of production – mould curing and mandrel curing. Typical formulation for cycle tyre and tube components.

Module IV : Fibres, Plastics & Composites (20)

Natural Fibres: Introduction – definition of fibres – importance of fibres in modern life – Structural variations – fiber, fiber forming plastics, elastomers, natural fibres – source, production details, process properties and application of natural fibers like cotton, linen, jute coir and sisal. Commercial importance of other natural fibers such as sisal, flax

Animal fiber – brief description on silk, wool and other animal hairs.

Mineral fibers – Asbestos

Man-made Fibers: Production properties and application of commercially available forms of glass fibres, production process and application of derived fibres – viscose rayon, Carbon fiber – Production, composition, structure and properties of carbon fibre.

Production process – wet spinning, dry spinning, melt spinning, properties and application of Nylon 6, Nylon 66, Polyester, Acrylic Aramid, and Polyolefin fibers. Basic terms used in fiber science such as Denier, Tex, Tenacity, Filament, Yarn, Strand, Cord, Warp, Weft, Twist.

Composites and their Constituents: Polymer composites, history of composite, manufacture of resins like polyester, epoxy, polyurethanes, MF, PF, UF etc. Catalyst – initiators – accelerators – Fillers, metal oxides, metallic powders, mineral fillers and mold release agent, thermoplastic resins – PP, PE, ABS, Rule of mixtures.

Composite Moulds and Process: Open moulding process – contact moulding, Spray lay up, Wet lay up, Prepregs, Vacuum bag moulding, Pressure bag moulding etc – Filament winding, Pultrusion, Centrifugal casting.

Process machinery and suitability of hot press moulding – SMC and DMC, Cold press moulding, Resin injection / Resin transfer moulding, Pre-form moulding and vacuum injection moulding, designing of FRP moulds and products – selection of materials, process and design aspects like section thickness, flanges, corners and inserts. Materials for FRP moulds viz plaster of Paris, Wood, steel, FRP – cost calculation of composite products.

Selection of resin and reinforcement for individual products like pedal Boats, Tennis rackets, Helmets, Automobile bodies, Roofing sheets, Bath tubs, Water tanks – automobile part like Bumper, Dashboards, Steering Wheels.

Polymer hybrid composite materials (PHBCM) – processes application and design of nanocomposites – casting and coating.

Short fibre composites.

Plastic Technology: History of plastics – importance of plastics in modern life – advantages over other conventional materials, statistics, ecofriendly plastics – classification based on thermal response, origin and structure, T_g , T_m and T_f of plastics.

Plastic Compounding, Plastic Compounding Equipments, Additives used in Plastics: Fillers, Stabilisers, Coupling agents, Lubricants, Plasticizers, Antidegradents, Blowing agents, Cross linking agents and typical formulations.

Commodity Plastics: Industrial production – Different grades – application of PE – LDPE, HDPE, UHMWPE, PP-PS, PVC-PMMA, PMA

Engineering Plastics: Polymerisation different grades – application of following engineering plastics polyamides, polyacetals, Polycarbonates, polyester, thermoplastic, polyurethane etc.

Specialty Plastics: PTFE, PC TFE, PPO, PPS

Miscellaneous Plastics: Shellac, casein, bitumine plastics, CI resin & cellulose plastics.

Thermosetting Plastics: Raw materials – industrial production, resin manufacturing, moulding powder, properties and applications of MF, UF, PF EPOXY, ALKYL, SILICON, Thermosetting PU & UP RESIN.

Important Plastic Products: General idea about plastic product design – processing limitation – steps involved in plastic product design – functional, aesthetic design of products – comparison of plastic product with other conventional products – environmental impact of plastic products.

Moulded Products: General features of IM products – products based on HDPE, PP and other Polyolefines – Bucket, mug, bottle caps, chair etc – products based on PVC, PS, Nylon and polyester – Material selection procedure for product manufacturing by IM – moulded part design.

Blow Moulded and Thermoformed Products: Blow moulded products based on HDPE, PP and other plastics – processing details, production of PVC bottle, specification test on bottles, Blow moulding of pet bottles, thermoformed products based on polyolefins and other plastics – manufacturing of disposable glasses, egg cartons etc – rotational moulding – production of water tank from PP.

Extruded and Calendered Products: PVC pipe, production line of PVC pipe, classification of PVC pipes, specification test on PVC pipes, design features of PVC pipes, rigid and flexible PVC pipes – typical formulation, extruded products based on polyethylene and PP – extruded products based on engineering plastics, melt fracture – Calendered products based on PVC and their applications, configurations and cooling methods.

Miscellaneous Plastic Products and Finishing: Production of plastic gears – advantages and disadvantages of moulded and cut gears – casting of PMMA, powder

coated products, cellular plastics, PU foam – rigid PU foam – compression moulded and transfer moulded products with examples – finishing and machining of plastic products – jointing and assembling of plastic products – decorating of plastic products.

Module V : Polymer Processing and Testing (20 Mark)

Compounding Equipments: Principles of mixing – types of mixing, dispersive & distributive mixing – batch and continuous mixing – mastication and mechanism of mixing – two roll mixing – Banbury mixing – master batching – mixing variables – material feeding and discharge, rotor speed, fill factor, ram pressure, batch temperature, mixing sequences – upside down mixing batch and continuous mixers – open two roll mill – types – machine details, roll size, capacity, drive system, friction ratio, temperature control and safety devices, material for construction accessories, advantages and limitations – internal mixers, types – Banbury and intermix – important parts, working principle, capacity, drive system, temperature control, pressure control – fill factor and its significance, comparison with open two roll mill.

Design Elements: Rotor and chamber design, ram and door configurations, rotor and temperature control.

Mixing Variables: Feed rate, discharge and rotor speed, fill factor ram pressure, batch temperature and mixing sequences.

Continuous Mixers: Types of blenders single screw continuous mixers – double R mixer, MVX mixer – Farrell continuous mixer and transfer mixer co-rotating disc type mixers.

Kneaders and Blenders: Development in mixing technology.

Moulding – compression – transfer – and injection moulding.

Blank preparation – blank heating – water bath and ovens – high frequency and microwave heating – heat transfer – methods of heat transfer – Heating medium for presses comparison of electrical heating and steam heating.

Vulcanization methods other than moulding – Radiation vulcanization method – Batch vulcanization methods – autoclave – hot air oven – gas curing – peachy process – advantages and disadvantages.

Continuous vulcanization method – High pressure steam – hot air tunnel molten salt bath – fluidized bed – continuous drum cure microwave curing. Examples of products vulcanized by each method.

Moulding Techniques: Compression mould – importance of flash positive, semi-positive type types compression mould – injection moulding – different types – RIM, RRIM, examples of compression moulded and injection moulded products – comparison of injection moulding with compression moulding, advantages, injection moulding cycle. Transfer moulding process – comparison of compression and transfer moulding – advantages – examples of products – trouble shooting.

Casting: Principle of casting – material for casting – mould pattern – ejection techniques.

Rotational moulding: Principle and process.

Thermo Forming: Different methods – pressure forming, vacuum.

Extrusion Technology: Pipe extrusion, sheet forming process, split film extrusion, blow film extrusion, extrusion blow moulding, different methods, parision programming, wire coating.

Calendaring Technology: Production of supported and unsupported sheeting, textile coating – skim coating or topping, fractioning, spreading – advantages and disadvantages – comparison of calendaring and spreading, profile calendaring, advantages – major applications.

Extruders: Types – screw and ram extruder, hot feed and cold feed extruder – cross head (T-head extruder), dual extruders, vented extruders and twin-screw extruders – extrusion technology – important parts of extruders – screw, barrel. Feed hopper, die, head, screen pack, adapter, breaker plate, temperature control, compression ratio, size and capacity, L/D ratio of different extruders, drive system, comparison of rubber and plastic extruders – types of extruders and their functions – strainer, vented typed – design factors – screw and barrel design for controlling compression ratio, temperature control and methods of increasing the extrusion.

Calendars: Calendars – various configurations 3 roll, 4 roll, vertical, inverted L, Z etc – Calendaring Technology – Parts and their specifications – Temperature control for rolls – Roll, deflection and method of correction – Roll cambering, roll bending, roll crossing.

Introduction and Material Testing: Importance of quality assurance and Testing – quality – definition. Modern quality concepts, importance of quality control in polymer industry. Standards and specifications. Different standard organization. Procedure for accreditation of ISI certification. Role of standard organization in quality assurance and customer satisfaction. Importance of calibration of equipments in quality control & testing. Raw material testing – Testing of Additives - % purity of DPG, MBT, ZnO, moisture content of clay, silica, particle size determination of C-black by iodine / N₂ adsorption number or microscopic method – Thermal properties, thermal conductivity, flammability, vicat softening temperature, M. P., brittleness, sp. Heat, HDT – Electrical properties – Dielectric strength, dielectric constant, arc resistance – optical properties – Refractive index, stress optical sensitivity.

Specification test for ISNR and Latex Concentrate: Significance, principle and method of tests for ISNR – dirt content, volatile mater, ash content, N₂ content, Po and PRI, ASHT and Colour – Technical specifications of ISNR as per BIS – Specification test for concentrated latex – Significance, principle and methods of the following test – KOH No, VFA number mechanical stability time, Mg content, sludge and coagulum content, sp gravity, viscosity, TSC, DRC, Alkalinity etc. Technical specifications for conc. Latex as per BIS.

Physical Properties: Method of testing, specimen standards – principle of conditioning – equipment used – significance of following tests relevant to plastics and rubbers – TS, tear strength, tension set and compression set, hardness, abrasion resistance, resilience, flex cracking, impact strength, creep and cold flow, fatigue failure.

Importance of process ability tests – principle, method of testing, equipments used for cure – characteristic study – illustration with graphs and advantages of cure meters – different types of cure meters – Mooney viscometer, Rheometer, recent developments in Rheometer – Determination of melt flow index, bulk factor and shrinkage of plastic materials.

Polymer Product Testing: Tyre testing – Non-destructive and destructive testing of tyre – high way testing Endurance tests, plunger test – tube testing – Testing of cycle tyre and tube – cord strength, casing strength (carcass strength), joint adhesion strength etc.

Testing of dry rubber products – Importance of product testing – IS specifications and specific test procedures of cycle tyres and tubes, M. C. soles, Hawaii V-straps, tread rubber, ebonite, LPG tubings, Conveyor beltings – Testing of latex products – ASTM/IS specifications and specific test procedures of latex foam, surgical gloves, electricians glove, examination glove and condoms – Testing of Plastic product – PVC pipe – blood bag – water tank, disposable syringes – helmet – Impact test – Charpy and Izod.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.

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