

### RESEARCH AND DEVELOPMENT

Material Science Division (MSD) undertakes R&D projects leading to development of processes, products & devices based on different kinds of materials. Apart from development of materials with tailor made properties, the activities include development of technologies with cradle-to-grave concept.

#### Research Expertise

SRI has developed a number of technologies in various research areas involving synthesis and modification of polymers and chemicals. SRI's expertise in these areas along with the scope of activities are given below:

Research Areas	Research Scope	Expertise in Synthesis
<ul style="list-style-type: none"> <li>• Green Technologies</li> <li>• Strategic Polymers</li> <li>• Engineering Polymers</li> <li>• Smart Materials</li> <li>• Nanotechnology</li> <li>• Radiation Processing</li> <li>• Fluoropolymers</li> <li>• Biofuels &amp; Energy</li> <li>• Waste Utilization</li> <li>• Optical Polymers</li> <li>• Biomedical Polymers</li> <li>• Packaging</li> <li>• Automobile &amp; Transport</li> <li>• Paints &amp; Inks</li> <li>• Adhesives</li> <li>• Oils, Lubricants &amp; Greases</li> <li>• Textiles</li> <li>• Rubbers</li> <li>• Paper</li> </ul>	<ul style="list-style-type: none"> <li>• Process Development</li> <li>• Scale-up Studies</li> <li>• Synthesis</li> <li>• Polymer Modification</li> <li>• Process Optimization &amp; Validation</li> <li>• Performance &amp; Life Cycle</li> <li>• Data Generation</li> <li>• Application Development</li> <li>• Specialized Studies</li> <li>• Feasibility Studies</li> <li>• Structure – activity Correlation</li> <li>• Consultancy &amp; Trouble Shooting</li> </ul>	<ul style="list-style-type: none"> <li>• Derivatisation</li> <li>• Crosslinking</li> <li>• Sulphonation</li> <li>• Sulphation</li> <li>• Thiolation</li> <li>• Phosphation</li> <li>• Alkylation</li> <li>• Etherification</li> <li>• Esterification</li> <li>• Hydroxyalkylation</li> <li>• Fluorination</li> <li>• Polymerization                             <ul style="list-style-type: none"> <li>▪ Anionic</li> <li>▪ Cationic</li> <li>▪ Free Radical</li> <li>▪ Condensation</li> <li>▪ Addition</li> <li>▪ Grafting</li> <li>▪ Substitution</li> <li>▪ Radiation</li> </ul> </li> </ul>

#### Pilot Plant Facilities

MSD has state-of-the-art pilot plant facility for polymer processing, synthesis of chemicals and formulating coatings & adhesives. The facility includes:

<ul style="list-style-type: none"> <li>• Compression Molding Machine</li> <li>• Extruders</li> <li>• Injection Molding Machines</li> <li>• Multi Layer Film Plant</li> <li>• Thermoforming</li> </ul>	<ul style="list-style-type: none"> <li>• Kneader cum Pelletizer</li> <li>• Rubber Kneader</li> <li>• High Speed Mixer</li> <li>• Two Roll Mill</li> <li>• Heavy Duty Grinders</li> </ul>	<ul style="list-style-type: none"> <li>• Three Roll Mill</li> <li>• Bead Mill</li> <li>• High Speed Disperser</li> <li>• Ball Mill</li> <li>• Glass Lined Reactor</li> <li>• Pressure Reactor</li> </ul>
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### Technologies Developed by SRI

#### Nanotechnology

- Metal Containing Nanocomposites for Optical Application
- Nanophotocatalyst for Effluent Treatment
- Nanofluids for Improved Heat Transfer

#### Radiation Processing

- Specialty Coatings for Wooden Handicrafts
- Cross-linked Polyamides
- Pressure Sensitive Adhesives
- Shelf Life Enhancement of Fruits & Vegetables
- Epoxy Composites
- Destruction of PCBs
- Optical Plastics

#### Utilization of Waste & Renewable Resources

- Recycled Rubber – Flyash Tiles
- Cellular Lightweight Concrete
- Process Engineered Fuel
- Low Cost Sanitary Napkins & Diapers
- Micronized Teflon
- Novel Green Composites

#### Strategic Polymers

- Bootings for Master Slave Manipulator
- Radiation Resistant Lip Seals
- Perfluorinated Lubricants
- Fluoroelastomers
- Centering & Driving Bands for Projectiles

#### Engineering Plastics

- Composites
- Smart Polymers
- Modified Polymer for High Mechanical & Thermal Properties

#### Biomedical Application

- Disposable Speculum
- Spectacle Lenses, Contact Lenses & Intraocular Lenses
- Wound Dressings from Textile Waste & Plant Fiber
- Personal Care Products
- Bio Absorbable Sutures
- Super Absorbent Polymers
- X-Ray Resistant Garments
- Dental Cement
- Antimicrobial Textiles
- PSA Tapes



### ANALYTICAL SUPPORT: PAINTS, INKS AND ALLIED PRODUCTS

<p><b>Enamel Paint</b></p> <ul style="list-style-type: none"> <li>➤ Synthetic: Exterior and Interior Purpose</li> <li>➤ Epoxy Glossy Enamel (Two Components)</li> <li>➤ Polyurethane Full Gloss Enamel</li> </ul> <p><b>Ready Mixed Paint/Others</b></p> <ul style="list-style-type: none"> <li>➤ For General Purpose</li> <li>➤ For Railway Coaches</li> <li>➤ Stoving Paints</li> <li>➤ Brushing Bituminous Black, Lead-Free, Acid, Alkali &amp; Heat Resistant</li> <li>➤ Road Marking Paint</li> <li>➤ Antifouling Paint for Ship Bottoms and Hulls</li> <li>➤ Distemper (Dry/ Washable) &amp; Cement Paint</li> <li>➤ Plastic Emulsion Paint</li> <li>➤ Aluminium Paint for General Purpose</li> </ul>	<ul style="list-style-type: none"> <li>➤ Heat Resistant Aluminium Paint</li> <li>➤ Powder Coating</li> </ul> <p><b>Primer</b></p> <ul style="list-style-type: none"> <li>➤ Zinc Chromate Primer</li> <li>➤ Red Oxide-Zinc Chromate Primer</li> <li>➤ Epoxy-Zinc Phosphate Primer</li> <li>➤ Polyurethane-Zinc Phosphate (Two Pack) Primer for Exterior Painting of Railway Coaches</li> </ul> <p><b>Varnish</b></p> <ul style="list-style-type: none"> <li>➤ Varnish Finishing Exterior Synthetic, Air Drying and General Purpose</li> <li>➤ Varnish Medium for Aluminium Paint</li> <li>➤ Black Japan (Type A,B,C)</li> </ul> <p><b>Road Marking Material</b></p> <ul style="list-style-type: none"> <li>➤ Thermoplastic Material</li> </ul>	<ul style="list-style-type: none"> <li>➤ Glass Bead <ul style="list-style-type: none"> <li>▪ Type 1</li> <li>▪ Type 2 ( Drop on)</li> </ul> </li> </ul> <p><b>Ink</b></p> <ul style="list-style-type: none"> <li>➤ Fountain Pen Ink (Dye Based)</li> <li>➤ Ferrogallotannate</li> <li>➤ Stamp Pad Ink</li> <li>➤ Indelible Ink</li> </ul> <p><b>Allied Products</b></p> <ul style="list-style-type: none"> <li>➤ Knifing Stopper for Railway Coaches</li> <li>➤ Grey Fillers for Enamel Use over Primer</li> <li>➤ Putty for Use in Window Frame</li> <li>➤ Polyurethane based Knifing Fillers</li> <li>➤ Aluminium Paste for Paint</li> <li>➤ Sealing Wax</li> </ul> <p><b>Raw material</b></p> <ul style="list-style-type: none"> <li>➤ Pigments</li> <li>➤ Drier</li> </ul>
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<b>Analytical Parameters</b>		
<p>❖ <b>Physical and Chemical</b></p> <ul style="list-style-type: none"> <li>➤ Drying Time</li> <li>➤ Viscosity (Flow cup no.4)</li> <li>➤ Finish</li> <li>➤ Fineness of Grind</li> <li>➤ Gloss (60°, 20° &amp; 45°)</li> <li>➤ Colour</li> <li>➤ Water Content</li> <li>➤ Wet Opacity</li> <li>➤ Flexibility and Adhesion</li> <li>➤ Flash Point</li> </ul>	<ul style="list-style-type: none"> <li>➤ Accelerated Storage Stability</li> <li>➤ Dry Film Thickness</li> <li>➤ Mass in kg/10 Lit.</li> <li>➤ Composition : Volume Solids, Phthallic anhydride.</li> <li>➤ Accelerated Tests: Resistance to <ul style="list-style-type: none"> <li>▪ Sulphuric Acid</li> <li>▪ Caustic Potash</li> <li>▪ Oil</li> <li>▪ Solvents</li> </ul> </li> <li>➤ Durability Test</li> </ul>	<ul style="list-style-type: none"> <li>➤ Colour Fastness to Light</li> <li>➤ Washability &amp; Cleanability</li> <li>➤ Temperature Stability</li> <li>➤ Ratio of Ethyl Acetate Extract to Iron Content</li> <li>➤ Compatibility with Thinner</li> <li>➤ Resistance to Wear</li> <li>➤ Resistance to Bleeding</li> <li>➤ Volume Solid</li> <li>➤ Relative Consistency</li> <li>➤ Resistance to Salt Spray</li> </ul>

<ul style="list-style-type: none"> <li>➤ Recoating Properties</li> <li>➤ Outdoor Exposure</li> <li>➤ Accelerated Weathering Test</li> <li>➤ Protection against Corrosion under Condensation</li> <li>➤ Volatile Matter</li> <li>➤ Resistance to Water</li> <li>➤ Resistance to Alkali</li> <li>➤ Resistance to Acid</li> <li>➤ Resistance to Chlorine</li> <li>➤ Lead Free Material</li> <li>➤ Heavy Metals</li> <li>➤ Pot Life</li> <li>➤ Pigment Composition</li> <li>➤ Cracking Resistance at Low Temperature</li> <li>➤ Binder Content</li> <li>➤ Softening Point</li> <li>➤ Luminance Factor</li> <li>➤ Titanium Dioxide</li> <li>➤ Calcium Carbonate &amp; Inert Fillers</li> <li>➤ Free Flowing Properties of Glass Beads</li> <li>➤ Gradation of Glass Beads</li> <li>➤ Glass Beads Content</li> <li>➤ Flow Resistance</li> <li>➤ Roundness of Glass Beads</li> <li>➤ Iron Content</li> <li>➤ Sedimentation</li> <li>➤ Corrosion</li> <li>➤ Hue and Intensity of Colour Penetration &amp; Permanence</li> </ul>	<ul style="list-style-type: none"> <li>➤ Freedom from Clogging</li> <li>➤ Stability</li> <li>➤ Colour Uniformity &amp; Intensity</li> <li>➤ Test for Resistance to Light</li> <li>➤ Glycerol (Glycerin Content)</li> <li>➤ Performance</li> <li>➤ Odour &amp; Fuming</li> <li>➤ Adhesion to Surface</li> <li>➤ Heat Resistance</li> <li>➤ Resistance to Heat Polymerization</li> <li>❖ <b>Instruments</b></li> <li>➤ Wet Abrasion Tester</li> <li>➤ Flow Cup No. 4</li> <li>➤ Wear Resistance Apparatus</li> <li>➤ Scratch Hardness Apparatus</li> <li>➤ Pressure Test Apparatus</li> <li>➤ Atomic Absorption Spectrophotometer</li> <li>➤ Cupping Tester</li> <li>➤ Hegman Gauge</li> <li>➤ Gloss Meter (60°, 20° &amp; 45°)</li> <li>➤ Humidity Cabinet</li> <li>➤ Coat Measure</li> <li>➤ Colour Spectrophotometer</li> <li>➤ Skid Resistance Tester</li> <li>➤ Flow Resistance Tester</li> <li>➤ Cylindrical &amp; Conical Mandrel</li> <li>➤ Metal Pyknometer</li> <li>➤ Salt Spray Chamber</li> <li>➤ Q Sun Weather-o-Meter</li> </ul>	<ul style="list-style-type: none"> <li>➤ Centrifuge Machine</li> <li>➤ Pfund Cryptometer</li> <li>➤ Abel Close Cup Flash Point Apparatus</li> <li>➤ Sun Tester</li> <li>➤ UV 2000 (Atlas)</li> <li>➤ UV-Visible Spectrophotometer</li> <li>❖ <b>Focus Areas</b></li> <li>➤ Development of Products</li> <li>➤ Technology for Generalized &amp; Specialized Application</li> <li>➤ Modification of Existing Process for Paint Manufacturing</li> <li>➤ Import Substitution</li> <li>❖ <b>Protocols Followed</b></li> <li>➤ Bureau of Indian Standards (BIS)</li> <li>➤ American Society for Testing and Materials (ASTM)</li> <li>➤ British Standards (BS)</li> <li>➤ International Organisation for Standardization (ISO)</li> <li>➤ Customer/Sponsor Provided Specification</li> <li>➤ Ministry of Road Transport &amp; Highways Specification (MORTH)</li> <li>➤ American Association of State Highways &amp; Transportation Official (AASHTO)</li> </ul>
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### ANALYTICAL SUPPORT : PAPER, LEATHER AND ALLIED PRODUCTS

<ul style="list-style-type: none"> <li>• Writing and Printing Paper</li> <li>• Photocopier Paper</li> <li>• Newsprint Paper</li> <li>• Carbon Paper</li> <li>• Kraft Paper</li> <li>• Pleated Filter Paper</li> <li>• Computer Paper</li> <li>• Germination Paper</li> </ul>	<ul style="list-style-type: none"> <li>• Paper Board</li> <li>• Solid Press Board</li> <li>• Type Writer Ribbons</li> <li>• Diaries</li> <li>• Tissue Paper</li> <li>• Blotting Paper</li> <li>• Stencil Paper</li> <li>• Coated and Art Paper</li> <li>• Cover Paper</li> </ul>	<ul style="list-style-type: none"> <li>• Office Paste</li> <li>• Corrugated Boxes / Cartons</li> <li>• Exercise / Drawing Note Books</li> <li>• Calendars</li> <li>• File Covers</li> <li>• Leather Cloth</li> <li>• Footwear</li> </ul>	<ul style="list-style-type: none"> <li>• Upholstery</li> <li>• Bags</li> <li>• Belts</li> <li>• Leather Goods</li> <li>• Leather Garments</li> <li>• Wallets</li> <li>• Toys</li> <li>• Shoe Sole</li> <li>• Covers</li> <li>• Gloves</li> </ul>
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#### Analytical Parameters

<p>❖ <b>Physical and Mechanical</b></p> <ul style="list-style-type: none"> <li>• Dimensions / Size</li> <li>• Thickness</li> <li>• Weight/Mass/Substance / Grammage</li> <li>• Bulk</li> <li>• Tensile Strength/Tensile Index</li> <li>• Elongation at Break</li> <li>• Tear Strength (Elmendorf)</li> <li>• Tear Index</li> <li>• Bursting Strength (Mullen Type)</li> <li>• Burst Factor/Burst Index</li> <li>• Adhesive Strength</li> <li>• Hardness</li> <li>• Smoothness &amp; Porosity</li> <li>• Double Fold</li> <li>• Bending Stiffness</li> <li>• Edgewise Crush</li> <li>• Flat Crush</li> <li>• Pore Size (Mean &amp; Maximum)</li> <li>• Durability</li> <li>• Recuperation</li> <li>• Typed Work</li> <li>• Resistance of Writing Paper to Feathering</li> <li>• Grammage of Each Ply (Corrugated Box)</li> <li>• Brightness</li> <li>• Opacity</li> </ul>	<ul style="list-style-type: none"> <li>• Gloss</li> <li>• Water Absorbency</li> <li>• Cobb Test</li> <li>• Fastness to Light</li> <li>• Flexing Demattia</li> <li>• UV Resistance</li> <li>• Thermal Stability</li> <li>• Ozone Resistance</li> <li>• Durability Test</li> <li>• Mildew Resistance</li> <li>• Coefficient of Friction</li> <li>• Abrasion Resistance</li> <li>• Thermal Conductivity</li> <li>• Flame Spread Test</li> <li>• Smoke Density</li> <li>• Toxicity Index</li> <li>❖ <b>Chemical</b></li> <li>• Water Soluble Chloride</li> <li>• Water Soluble Sulphate</li> <li>• Ash Content</li> <li>• Mass of Coating</li> <li>• Heavy Metals (Cadmium, Mercury, Lead, Arsenic)</li> <li>• Solid Content</li> <li>• Surface pH</li> <li>• pH of Aqueous Extract</li> <li>• Matter Soluble in Ether</li> <li>• Benzene Soluble Matter</li> <li>• Moisture Content</li> <li>• Volatile Content</li> <li>• Water Soluble Matter</li> <li>• Solvent Extractable Matter</li> </ul>	<ul style="list-style-type: none"> <li>• Nitrogen Content</li> <li>• Chromium Content</li> <li>• Aluminium Content</li> <li>• Iron Content</li> <li>• Copper Content</li> <li>• Silica Content</li> <li>• Total Chloride Content</li> <li>• Formaldehyde Content</li> <li>• Oil Content</li> <li>• Hide Substance</li> <li>• Degree of Tannage</li> <li>• Sulphated Ash</li> <li>• Water Insoluble Ash</li> <li>• Water Soluble Organics</li> <li>• Chromic Oxide</li> <li>• Zirconium Content</li> <li>• Water Soluble Magnesium Salt</li> <li>• Sugar Content as Glucose</li> <li>• Corrosion Resistance</li> <li>• Phosphorus Content</li> <li>• Chemical Resistance</li> <li>❖ <b>Instruments</b></li> <li>• Universal Tensile Testing Machine</li> <li>• Bursting Strength Apparatus (Mullen Type)</li> <li>• Elmendorf Tear Tester</li> <li>• Sun Tester CPS (+)</li> <li>• Q Sun Weather-o-Meter</li> <li>• Polarizing Microscope</li> <li>• pH Meter</li> </ul>	<ul style="list-style-type: none"> <li>• Weighing Balance</li> <li>• Atomic Absorption Spectrophotometer</li> <li>• UV-Visible Spectrophotometer</li> <li>• Gas Chromatographs</li> <li>❖ <b>Protocols Followed</b></li> <li>• Bureau of Indian Standards (BIS)</li> <li>• American Society for Testing and Materials (ASTM)</li> <li>• British Standards (BS)</li> <li>• International Organisation for Standardization (ISO)</li> <li>• Customer/Sponsor Provided Specifications</li> <li>❖ <b>Specialized Studies</b></li> <li>• Studies Related to Various Environmental Exposures:</li> <li>• High Temperature</li> <li>• Low Temperature</li> <li>• Thermal Shock</li> <li>• Relative Humidity</li> <li>• Fungus Growth</li> <li>❖ <b>Other Services</b></li> <li>• Setting-up of New Laboratory</li> <li>• Quality Assurance Services</li> <li>• Third Party Inspection</li> </ul>
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### ANALYTICAL SUPPORT : TEXTILE AND ALLIED PRODUCTS

<ul style="list-style-type: none"> <li>• Uniform Clothes</li> <li>• Carpets</li> <li>• HDPE/PP Bags</li> <li>• Jute Bags</li> <li>• Bitumen Felts</li> <li>• Socks</li> <li>• Jerseys/Sweaters</li> <li>• Yarn/Threads</li> <li>• Towels</li> </ul>	<ul style="list-style-type: none"> <li>• Geo-Textiles</li> <li>• Bed Sheets</li> <li>• Cotton Canvas</li> <li>• Cotton Bandages</li> <li>• Cotton Drill</li> <li>• Tarpaulins</li> <li>• Woolen Felts</li> <li>• School Bags</li> <li>• Cloth Bags</li> </ul>	<ul style="list-style-type: none"> <li>• Ropes/Twines</li> <li>• Blankets</li> <li>• Woolen Shawl</li> <li>• Filter Cloth</li> <li>• Inner Vest</li> <li>• Binding Cloth</li> <li>• Rain Coat</li> <li>• High Efficiency Floorings</li> </ul>	<ul style="list-style-type: none"> <li>• Mosquito Nets</li> <li>• Mesh Nets</li> <li>• Webbing</li> <li>• Flame Retardant Fabrics</li> <li>• Woolen Serge</li> <li>• Upholstery/Vinyl Coated Fabrics</li> <li>• Cloth Shirting Angola</li> </ul>
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Analytical Parameters			
<p><b>❖ Physical &amp; Mechanical</b></p> <ul style="list-style-type: none"> <li>• Dimensions</li> <li>• Thickness</li> <li>• Weight/Mass</li> <li>• Threads/Dm</li> <li>• Twist Per Inch</li> <li>• Count of Yarn</li> <li>• Breaking/Tensile Strength</li> <li>• Elongation at Break</li> <li>• Tear Strength (Tongue/ Elmendorf)</li> <li>• Peel Strength</li> <li>• Bursting Strength (Mullen Type &amp; Ball Bursting)</li> <li>• Puncture Resistance</li> <li>• Martindale Abrasion</li> <li>• Pilling</li> <li>• De-Mattia Flexing</li> <li>• Crease Recovery Angle</li> <li>• Storage Sticking Test</li> <li>• Fibre Diameter/Fibre Fineness</li> <li>• Type of Weave</li> <li>• Pile Density</li> <li>• Shorn Pile Weight</li> <li>• Tuft Withdrawal Force</li> <li>• Pile Height</li> <li>• Pile Thickness</li> <li>• Pressure Head Test</li> <li>• Water Spray Test</li> <li>• Cone Test</li> <li>• Water Penetration Test</li> </ul>	<p><b>❖ Chemical</b></p> <ul style="list-style-type: none"> <li>• Identification of Fibres &amp; Blend</li> <li>• Scouring Loss</li> <li>• Water Soluble Matter</li> <li>• Ether Soluble Matter</li> <li>• Chloride Content</li> <li>• Azo Dyes</li> <li>• Dimensional Change to Water</li> <li>• Dimensional Change to Washing</li> <li>• Total Pile Weight</li> <li>• Colour Fastness to Water</li> <li>• Colour Fastness to Organic Solvents</li> <li>• Colour Fastness to Sea Water</li> <li>• Colour Fastness to Shampooing</li> <li>• Sulphate Content</li> <li>• DDT Content</li> <li>• Oil Content</li> <li>• pH of Aqueous Extract</li> <li>• Heavy Metal Analysis (Mercury, Arsenic, Cadmium, Lead)</li> <li>• PCP Content</li> <li>• Benzidine Content</li> <li>• Pile Composition</li> <li>• Ash Content</li> <li>• Moisture Content</li> <li>• Colour Fastness to Artificial Light/ Day Light</li> <li>• Colour Fastness to Washing</li> </ul>	<ul style="list-style-type: none"> <li>• Colour Fastness to Perspiration</li> <li>• Colour Fastness to Hot Pressing</li> <li>• Colour Fastness to Rubbing (Dry &amp; Wet)</li> <li>• Vertical Flammability</li> <li>• Horizontal Flammability</li> <li>• Tablet Test</li> <li>• Limiting Oxygen Index</li> <li>• Toxicity Index</li> </ul> <p><b>❖ Instruments</b></p> <ul style="list-style-type: none"> <li>• Universal Tensile Testing Machine</li> <li>• Sun Test CPS (+)</li> <li>• Q Sun Weather-o-Meter</li> <li>• UV 2000 (Atlas)</li> <li>• Polarizing Microscope</li> <li>• Bursting Strength Apparatus (Mullen Type)</li> <li>• Elmendorf Tear Tester</li> <li>• Storage Sticking Apparatus</li> <li>• Pressure Head Tester</li> <li>• Crease Recovery Apparatus</li> <li>• De-Mattia Flexing Test Apparatus</li> <li>• Carpet Thickness Gauge</li> <li>• pH Meter</li> <li>• Weighing Balance</li> <li>• Washing Machine</li> <li>• Digi-Crock</li> <li>• Digi-Pill</li> <li>• Digi-Twist</li> </ul>	<ul style="list-style-type: none"> <li>• Digi-Wash</li> <li>• Martindale Abrasion Tester</li> <li>• Perspirometer</li> <li>• Colour Matching Cabinet</li> <li>• Atomic Absorption Spectrophotometer</li> <li>• UV Visible Spectrophotometer</li> <li>• Gas Chromatographs</li> </ul> <p><b>❖ Protocols Followed</b></p> <ul style="list-style-type: none"> <li>• Bureau of Indian Standards (BIS)</li> <li>• American Society for Testing and Materials (ASTM)</li> <li>• British Standards (BS)</li> <li>• International Organisation for Standardization (ISO)</li> <li>• Customer/Sponsor Provided Specification</li> </ul> <p><b>❖ Specialized Studies</b></p> <ul style="list-style-type: none"> <li>• Studies Related to Various Environmental Exposures: <ul style="list-style-type: none"> <li>• High Temperature</li> <li>• Low Temperature</li> <li>• Salt Mist</li> <li>• Thermal Shock</li> <li>• Rain, Relative Humidity</li> <li>• Fungus Growth</li> </ul> </li> </ul> <p><b>❖ Other Services</b></p> <ul style="list-style-type: none"> <li>• Setting-up of New Laboratory</li> <li>• Quality Assurance Services</li> <li>• Third Party Inspection</li> </ul>

### ANALYTICAL SUPPORT : RUBBER, PLASTICS AND ALLIED PRODUCTS

<ul style="list-style-type: none"> <li>• Black LDPE Films</li> <li>• HDPE Films</li> <li>• Multilayered Cross Laminated Films</li> <li>• PVC/UPVC Pipes</li> <li>• HDPE Pipes</li> <li>• Tarpaulins</li> <li>• Conveyor Belts</li> <li>• Surgical Rubber Gloves</li> <li>• V- Belts</li> <li>• Cycle Tubes</li> </ul>	<ul style="list-style-type: none"> <li>• Tubal Rings</li> <li>• Copper-T</li> <li>• Latex Condoms</li> <li>• PLB HDPE Ducts</li> <li>• Non-percolating Fire Fighting Hose</li> <li>• Decorative Thermosetting Laminate</li> <li>• Rigid Cellular Foam</li> <li>• Plywood Adhesives (Phenolic and Amino)</li> </ul>	<ul style="list-style-type: none"> <li>• Polymeric Bitumen Membrane</li> <li>• PET Bottles</li> <li>• HDPE Water Tanks</li> <li>• Fiber-reinforced Composite Cylinders</li> <li>• Reflective Road Stud</li> <li>• Foot Rest</li> <li>• Rubber Hose</li> <li>• Rubber Grommet</li> <li>• Geo-grid/Geo-membrane</li> </ul>	<ul style="list-style-type: none"> <li>• Polycarbonate Globe</li> <li>• PVC Flooring</li> <li>• Epoxy Flooring</li> <li>• False Ceiling</li> <li>• Water-proofing Membrane</li> <li>• CPVC Sprinkler Pipe</li> <li>• PPR Pipe</li> <li>• FRP Pipe</li> <li>• Rubber Hose</li> <li>• PTFE Products</li> <li>• PVC Shoes</li> <li>• Plastic Chairs</li> </ul>
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#### Analytical Parameters

<p>❖ <b>Physical and Mechanical</b></p> <ul style="list-style-type: none"> <li>• Dimensions</li> <li>• Thickness</li> <li>• Density/Specific Gravity</li> <li>• Bulk Density</li> <li>• Resistance to Indentation</li> <li>• Weight/Mass</li> <li>• Tensile Strength</li> <li>• Elongation at Break</li> <li>• Flexural Strength</li> <li>• Tear Strength (Tongue/ Elmendorf)</li> <li>• Bursting Strength (Mullen Type)</li> <li>• Peel Strength</li> <li>• Bond Strength</li> <li>• Intrinsic Viscosity</li> <li>• Particle Size</li> <li>• Puncture Resistance</li> <li>• Adhesion Strength</li> <li>• Hardness (Shore A , Shore D &amp; IRHD)</li> <li>• Indentation Hardness Index</li> <li>• Melt Flow Index/Rate</li> <li>• Flexing Test</li> <li>• Compression Test</li> <li>• Compression Set</li> <li>• Izod Impact Test</li> <li>• Dart Impact Test</li> <li>• Abrasion (Taber)</li> <li>• Heat Deflection Temperature (HDT)</li> <li>• Vicat Softening</li> </ul>	<ul style="list-style-type: none"> <li>• Temperature (VST)</li> <li>• Dimensional Stability</li> <li>• Reversion</li> <li>• Opacity of Pipes</li> <li>• Vacuum Collapse Test</li> <li>• Carbon Black Dispersion</li> <li>• Thermal Conductivity</li> <li>• Hydraulic Test on Pipes</li> <li>• Pressure-head Test</li> <li>• Water Penetration Test</li> </ul> <p>❖ <b>Chemical</b></p> <ul style="list-style-type: none"> <li>• Identification of Polymers</li> <li>• Chlorine Content</li> <li>• Nitrogen Content</li> <li>• Vinyl Chloride Monomer Content</li> <li>• Moisture Content</li> <li>• Volatile Content</li> <li>• Ash Content and Analysis</li> <li>• Sulphated Ash Content</li> <li>• K-Value</li> <li>• Ozone Resistance</li> <li>• Water Absorption</li> <li>• Plasticizer Content</li> <li>• Thermo Gravimetric Analysis (TGA)</li> <li>• Differential Scanning Calorimetry (DSC)</li> <li>• Thermal Stability</li> <li>• Carbon Black Content</li> <li>• Moisture Vapor Transmission Rate (MVTR)</li> <li>• Halogen Acid Gas Evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Titanium Dioxide Content</li> <li>• Overall Migration</li> <li>• Resistance to Chemicals</li> <li>• Rubber Content</li> <li>• Sulphur Content</li> <li>• Heavy Metal Analysis</li> <li>• Solvent Extractable Matter</li> <li>• Biodegradability</li> <li>• Photodegradability</li> <li>• Weathering Exposure</li> <li>• UV Exposure</li> <li>• UL Flammability</li> <li>• Limiting Oxygen Index</li> <li>• Toxicity Index</li> <li>• Smoke Density</li> <li>• Oxidation Induction Time</li> <li>• Vertical Flammability</li> <li>• Horizontal Flammability</li> </ul> <p>❖ <b>Instruments</b></p> <ul style="list-style-type: none"> <li>• Universal Tensile Testing Machine</li> <li>• Q Sun Weather-o-Meter</li> <li>• UV 2000 (Atlas)</li> <li>• Sun Tester CPS (+)</li> <li>• Climatic Chamber</li> <li>• Toxicity Chamber</li> <li>• Izod Impact Tester</li> <li>• Melt Flow Indexer</li> <li>• Indentation Hardness Tester</li> <li>• Polarizing Microscope</li> <li>• Bursting Strength</li> </ul>	<ul style="list-style-type: none"> <li>• Apparatus (Mullen Type)</li> <li>• Elemendorf Tear Tester</li> <li>• Brittleness Apparatus</li> <li>• Dart Impact Tester</li> <li>• Low Temperature Viscosity Bath</li> <li>• Abrasion Tester</li> <li>• Pressure Head Tester</li> <li>• Thermal Conductivity Apparatus</li> <li>• HCL Gas Generation Apparatus</li> <li>• Carbon Black Content Apparatus</li> <li>• Ozone Resistance Apparatus</li> <li>• HDT/VST Apparatus</li> <li>• Smoke Density Apparatus</li> <li>• Limiting Oxygen Index Apparatus</li> <li>• Oxygen Induction Time Apparatus</li> <li>• Thermo Gravimetric Analyser</li> <li>• Differential Scanning Calorimeter</li> <li>• Flammability Apparatus (FMVS/UL)</li> <li>• Impact Testers</li> <li>• Atomic Absorption Spectrophotometer</li> <li>• UV-Visible Spectrophotometer</li> <li>• Gas Chromatographs</li> </ul>
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