

SHRIRAM INSTITUTE FOR INDUSTRIAL RESEARCH- IN THE SERVICE OF INDUSTRY AND SOCIETY

MANDATE & VISION

SRI was founded with the basic objective of providing support by way of industrial research and development and technical services of various types to the industry. The mandate and vision for the Institute as given by the visionary founder Lala Shri Ram was quite clear and straight forward: "Institute would operate as a not-for-profit and completely self-sustainable organisation". This mandate was basically meant for ensuring the truly independent and completely unbiased research facility dedicated to all concerned but mainly to the industry. The importance of indigenous R&D for the growth of the industry and consequently the economic development of the country was realised by the Founder of the Institute well before the country ushered itself in the era of industrialisation. To convert this vision into reality, SRI was founded.

GROWTH PATH

Shriram Institute for Industrial Research started functioning in the year 1950. In 1981, Bangalore unit was started in a modest way and in 1984 it was fully operational with the state-of-the-art laboratory facilities. SRI's Bangalore branch today, is working on the same philosophy as SRI Delhi and takes care of the research and analytical needs of the Southern part of India. Since 2006, SRI's Gurgaon unit has also become operational as a Sample Collection Centre to start with.

The R&D experience and expertise of the Institute has been growing with time and very much in accordance with the trends of the industry. With the growth and change in the requirements of the Indian industry, Shriram Institute has been diversifying its activities into various newer areas to support the upcoming technical needs of the industry.

SHRIRAM INSTITUTE : OPERATIONAL DIVISIONS

Over the years, various divisions of SRI have been set up to take care of the different areas of activities and these divisions have seen a consistent growth with time.

- ❖ Material Sciences
- ❖ Bio-Sciences including Toxicology
- ❖ Analytical Sciences
- ❖ Shriram Applied Radiation Centre (SARC)
- ❖ Environment Protection
- ❖ Calibration and Energy Labeling

MATERIAL SCIENCE DIVISION

Material Science Division (MSD) is engaged in the research and development for various types of materials including polymers and polymeric materials.

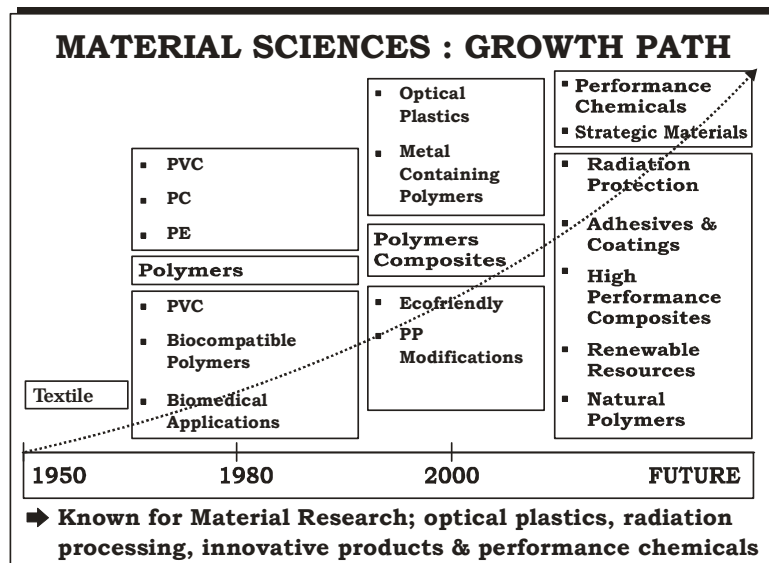
The division undertakes time-bound contract research projects dealing with various aspects of products, processes and applications. The services offered by SRI cover all stages

essential for entrepreneurial growth starting from identification, assessment, development and demonstration to ensure commercialization of desired product. The division develops contemporary technologies in the context of globalization and hi-tech industrial competition and helps to upgrade the existing ones. How the scientists of SRI have been working for the industry can be appreciated from the role being played by SRI in the growth of the industry as shown below.

The expertise exists for materials for various industrial applications. The basic services offered include :

- Identification of new products, applications, processes and technologies
- Development of products, processes and technologies
- Improvements in the existing products & processes and making them cost effective by adopting alternative routes or using alternative raw materials
- Scale-up studies to take up the development work from the lab-scale to the commercial-scale
- Providing technical help in preparation of the data sheet for product application and material safety data sheet
- Providing technical opinion report on the existing products as well as processes by characterisation and performance evaluation.
- Product differentiation etc.

Growth Path of MSD



Core Research Areas :

- ❖ Polymeric products
- ❖ Composites
- ❖ Organic Synthesis
- ❖ Specialty Chemicals
- ❖ Herbal Products
- ❖ Renewable Resources
- ❖ Radiation based Technologies
- ❖ Waste Utilization

Focus Research Areas :

- ❖ Nanotechnology
- ❖ Packaging products
- ❖ Optical plastics
- ❖ Hygiene products
- ❖ Synergistic formulations
- ❖ Functional polymers
- ❖ Surfactants
- ❖ Bio-diesel

Polymeric Products

The research studies have been conducted on the following polymeric materials for which projects are being pursued regularly:

Polymer blends /alloys; composites; adhesives, coatings & lacquers; healthcare & bio-materials; process optimization; plastic waste utilization and modification of existing processes and import substitution

Organic Synthesis

Projects related to organic synthesis are regularly being undertaken to develop novel materials including polymers with desired characteristics. The research in this area includes developing alternative processes and finding out the alternative raw materials to make the product and process cost effective. Some of the recent projects undertaken with respect to organic synthesis are:

- Synthesis of metal containing polyacrylates for optical applications for development of nano-plastics with excellent physico-mechanical and optical properties.
- Synthesis of high refractive index novel polythiols for colorless, impact resistant, transparent and bubble free lenses.
- Synthesis of polyglycolic acid for surgical absorbable suture applications
- Synthesis of biodegradable polymers
- Derivatives of natural products such as carbohydrates.
- Development of process technologies for several biomedical applications such as, Bone Cement ; Dental Cement ; Blood Bag ; CAPD System

Polymer Composites

Some of the polymer composites developed include:

- Fire retardant Jute composite : A wood substitute composite of Jute replacing polyester and polystyrene with natural Euphorbia latex coagulum
- Mesta fibre composite : Composites of polypropylene/mesta fibre for automobiles.
- Insulated Laminated Boards : Fire retardant and antistatic laminates from waste ceramic fibre and polyester.
- Anti-fungus, anti-rodent PE compositions : for lamination on Jute fabric

Adhesives and Coatings

SRI has been working in the field of adhesives and coatings. Some of the adhesives and coatings developed are:-

- Water based adhesive: For tyre retreading in the form of a stable aqueous dispersion.
- Hot melt adhesive: For bookbinding application.
- Surface coating formulations for wood laminates
- Water repellent coating for glass: Highly effective water and dust repellent coating formulation using indigenous raw materials, for window panels for high rise buildings.
- Road marking paint : Having long lasting, luminescent, weather and friction resistant properties.

CHARACTERIZATION AND STRUCTURE ELUCIDATION OF MATERIALS

A. Characterisation of polymeric materials by :

❖ Physical & mechanical properties

- Hardness; Density; Dimensional stability; Tensile strength; Flexural strength; Impact strength & Compressive strength
- Young's Modulus

❖ Flammability studies

- Flame retardance (UL)
- Toxicity index
- Limiting Oxygen Index (LOI)
- Smoke density

❖ Thermal properties by means of :-

- Differential scanning calorimetry
- Thermo-gravimetry
- Vicat softening point
- Heat deflection temperature
- Thermal ageing
- Melt flow index
- Melt elasticity parameters

❖ Electrical properties

- Dielectric constant
- Volume resistivity
- Breakdown voltage
- Dissipation factor
- Surface resistivity

❖ Life cycle analysis

- Xenon Arc weathering
- UV-Condensation weathering

❖ Migration studies

Packaging materials for Food; Drugs and Pharmaceutical Products.

B. Structure Elucidation of non-polymeric materials

- ❖ Chemical profiling of herbal extracts, Ayush products and various synthetic materials
- ❖ Reverse engineering of specialty formulations meant for industrial applications

Development of Methods and Validation of developed methods of Analysis

- ❖ Expertise to develop method for an existing as well as new product
- ❖ Expertise to validate an already developed method

Conducting Product Differentiation by:

- ❖ Performance evaluation and weathering studies for various materials such as :
 - EPDM/PVC in solar cells
 - EPDM/PP for automotives
 - Weather resistant PVC for cooling towers
 - Neoprene coated nylon fabric
 - HDPE woven sacks
 - Color fastness of coatings & textiles

Polymer Compounding

Based on the desired performance criteria and applications, special polymer compounds have been designed. Sufficient experience and expertise exists for compounding of various resins viz. PVC, PP, PE, PS, ABS, PC and rubber blends with various additives such as plasticizers, stabilizers, lubricants and specialty additives etc. for development of various products including:

- Cables for high performance applications
- PVC Flooring for household and industrial applications
- PVC Shoe soles with high abrasion resistance
- Automotive components
- Products for medical and biomedical applications such as Body Warmer Bags, Catheters, Blood Bags, CAPD Bags etc.
- Products for specialty applications & consumer items such as cling films, anti-rodent & anti-termite films etc.

Polymer Processing

Optimization of process parameters of various polymeric materials such as, Commodity plastics; Engineering plastics; Rubber compounds; Thermosets; Thermoplastic elastomers & Polymeric blends.

Polymer Modifications

The polymers are modified as per the needs for their applications using methods like:

- Compounding; Grafting; Alloying & blending: and Surface modification

A LIST OF AVAILABLE TECHNOLOGIES

- Blood Bag : Technology for blood bags meeting ISO 3826
- CAPD System for Continuous Ambulatory Peritoneal Dialysis
- Production of bone cement and bone substitute
- Disposable Vaginal Speculum : Disposable hygiene device replacing metallic one
- Body Warmer : A body warmer with repetitive usage
- Low cost disposable medical hygiene products : A unique hygiene product
- Synthesis of novel polythiols : High refractive index material
- Polyglycolic acid (PGA) based synthetic absorbable sutures Based on Glycolic acid
- Cling Film : For industrial and food packaging applications
- Rodent Repellent PE compositions for storage of grains in go-downs.
- Abrasion resistant low cost shoe soles based on PVC/PU blends and PVC/NBR blends
- PVC compositions for floor tiles
- High performance Cables PVC and PE based compositions crosslinkable by electron beam:
- Process Engineered Fuels (PEFs) from plastic wastes and agri wastes
- Technology for road construction using plastic waste

MAJOR R&D PROJECTS SUCCESSFULLY COMPLETED

- Anti-oxidants from natural sources
- Epoxidised oil from plant seeds
- Cardanol from cashew nut shell liquid
- Shelf-life enhancement of fruits
- Detoxification of aflatoxin in peanuts
- Epoxy based composites by electron beam curing process
- Wood polymer composites
- Remediation of polychlorinated biphenyls (PCBs)
- Surface coating for wood laminates
- Treatment of city sewage by radiation
- PVC compounds for wire and cable industry
- Coloration of Gem-stones
- Ordinary portland cement from flyash
- Tiles from ceramic fiber waste

ANALYTICAL SCIENCES DIVISION (ASD)

The Analytical Science Division, during its initial phase, started with quality control of materials. The major focus was on macro-analysis, which was mainly based on the various parameters of the materials and standardisation of methodologies for quality control of raw materials and finished products. With the changing times and growing awareness about the quality, there has been a major shift from macro analysis to microanalysis which mainly involves the determination of various residues, nutrients, toxins, adulterants and impurities, generally present at very low levels of ppm or ppb. Today with globalisation and implementation of WTO, SRI is fully equipped in terms of both, capacity and capability to meet the regulatory requirements of various international authorities.

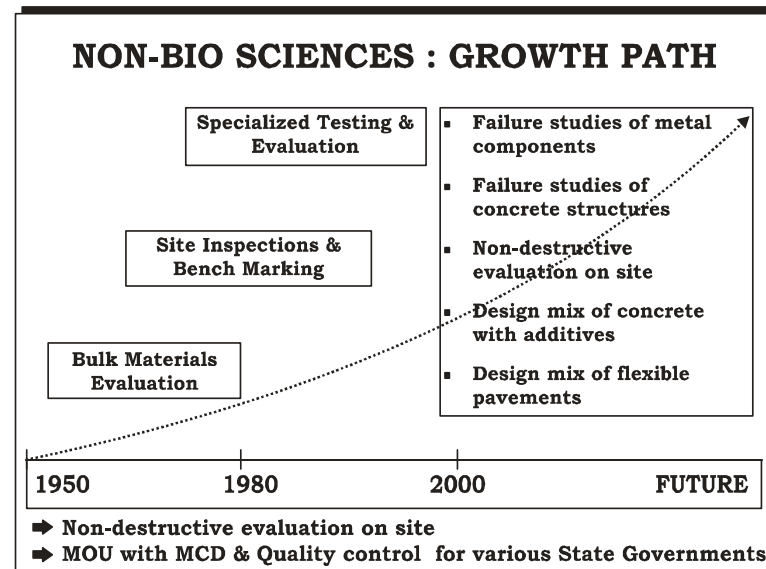
At present, SRI is providing the world class analytical services to the industry in the following areas:-

- Product and Process Development
- Automobiles
- Quality Control & Quality Assurance
- Environment Protection and Pollution Control
- Toxicology and Pharmacology
- Drugs and Pharmaceuticals
- Herbal and Traditional Medicines
- Food Processing
- Packaging Materials
- Chemicals and Agrochemicals
- Minerals and Ores
- Petrochemicals and Refineries
- Engineering and Infrastructure
- Calibration
- Electricals
- Consultancy and Quality Improvement
- Inspection
- Method Development and Validation
- Residue Analysis

Focus Areas of Analytical Sciences

- ❖ Quality evaluation of materials for infrastructure development
- ❖ Quality of products derived from petroleum resources as well as renewable resources
- ❖ Bench marking of products for quality and performance
- ❖ Development of methods for new materials

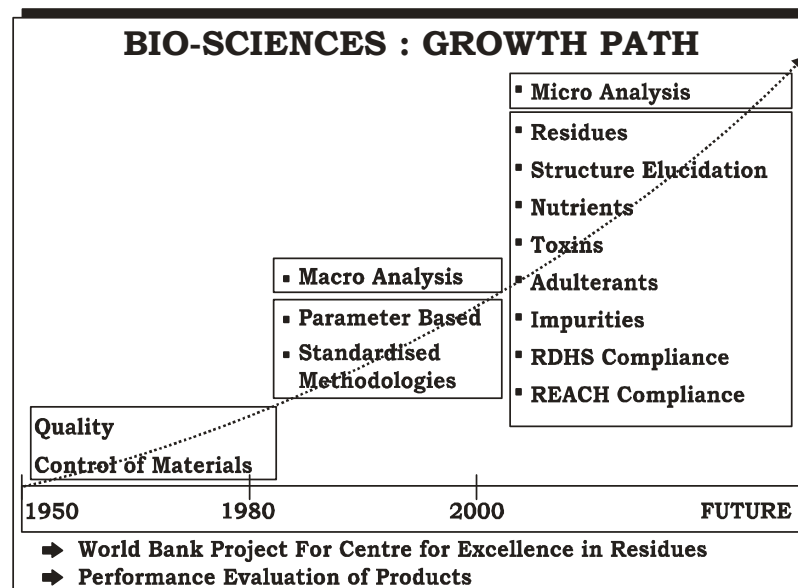
Growth Path of Non-Bio Sciences



MAJOR PROJECTS COMPLETED BY NON-BIO SCIENCES

- ❖ Quality assessment of already built up roads
- ❖ Assessment of probability of collapsing of overhead water tank
- ❖ Root cause analysis of rusting on the various components of a printing machine

Growth Path of Bio-Sciences



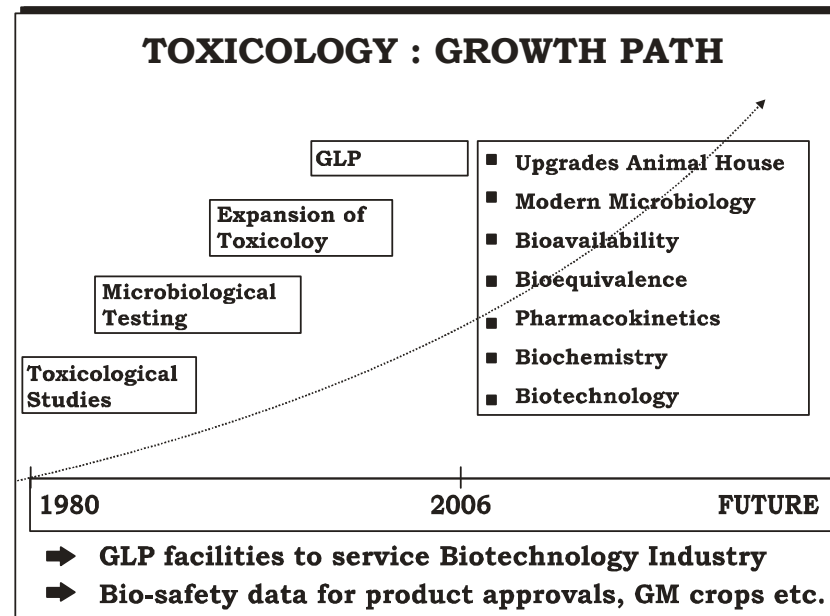
Focus Areas of Food Sector

- Nutraceuticals and functional foods
- Residues in foods and processed foods
- Packaging quality and leachability studies
- Nutritional evaluation and labelling
- Sanitary and phytosanitary
- Shelf life studies and Shelf life enhancement
- Radioactive contaminants

Focus Areas of Health Sector

- Acute Toxicity Studies
- Sub-Acute Toxicity Studies
- Reproduction Toxicity Studies
- Carcinogenicity Studies
- *in-vitro* Toxicity Studies
- Safety Evaluation of GMOs
- Genotoxicity Studies
- Pharmacokinetics, Bioavailability, Bioequivalence studies
- Stability Studies
- Analytical method development and validation
- Quality evaluation and inspection of drugs and pharma products
- Quality standardisation of herbal products
- Microbiological evaluations
- * **All Toxicity studies are being Conducted using GLP Animal facilities**

Growth Path of Toxicology



MAJOR PROJECTS COMPLETED BY BIO SCIENCES

- Analysis of imported Palm oil for fatty acid profile and physico-chemical properties
- Clinical Research Study on human volunteers for a US based MNC on hand wash products
- Detection of Salmonella in Acid Casein samples
- Microbiological analysis of cooked food samples
- Microbiological analysis of Foley catheters
- Shelf life and stability studies of drugs, pharmaceuticals and agrochemical products
- Quality survey of Ayurvedic drugs
- Study on presence of heavy metals & pesticide residues in medicinal plants
- Toxicological evaluation of various agro-chemicals
- Persistence studies of agrochemicals in crops, soil and water
- Safety evaluation of different GM Products
- Biocompatibility studies of a variety of medical devices

Today, besides the above, SRI is also providing other specialised services in the field of Inspection and Development in the areas as given below:-

Inspection

- Drugs and Pharma
- Food and Farm Products
- Building and Establishment
- Roads and Highways
- Ready Mixed Concrete
- Non-destructive evaluation
- Materials as per individual needs
- Auditing systems of Facilities
- Herbal and Traditional medicines

Development

- Designing RMC
- New products and process development
- Bio-compatibility studies
- Raw materials and finished products
- Validation of Process and method
- Shelf life and Stability studies
- Microbiological Evaluation
- Bio-availability and bio-equivalence

CALIBRATION

SRI Calibration Laboratory provides valid and accurate measurements using updated standards having unbroken chain of traceability to National and International Standards.

Provides wide range of facilities in different disciplines viz.

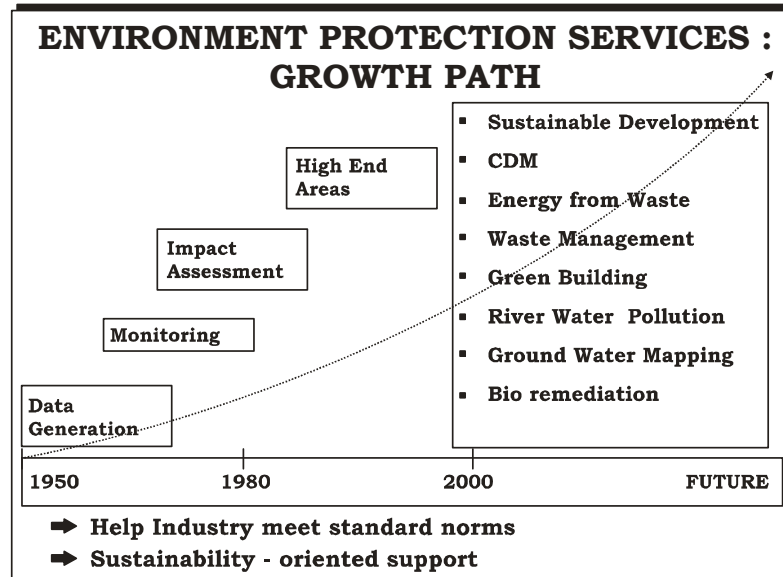
Thermal ; Mass; Volume; Density; Pressure/ vacuum ; Dimension ; Force ; Time; Rheology (viscosity); Electrical devices; Analytical instruments

It also undertakes on-line/ on-site calibration jobs.

ENVIRONMENT PROTECTION SERVICES (EPS)

Environment Protection Services of SRI is having multi-disciplinary areas, which caters to the demands of wide-spectrum of clientele for regulatory requirements, consultancy for new projects, process validation etc.

Growth Path of Environment Protection Services



Focus Areas of EPS:-

- ❖ Monitoring of projects for Environment Impact Assessment in following areas :
 - River water
 - Ground water
 - Air
 - Soil
- ❖ Bio-remediation of contaminated water
- ❖ Biodegradability studies
- ❖ Waste management and value added products from non-biodegradable waste

Major thrust areas of EPS:-

- ❖ **EIA; EMP Preparation; Risk Assessment and Disaster Management Plan**

SRI provides professional consultancy services to execute EIA/EMP projects (both comprehensive & rapid) as per the guidelines of Ministry of Environment & Forests, which includes:

- Generation of baseline environmental data.
- Pollutant dispersion modeling.

- Data interpretation & Impact Analysis.
- Development of EMP to address various environmental issues as well as to reduce the negative impacts and enhance the positive impacts.
- Risk analysis based on HAZOP, HAZAN, Fault Tree Analysis, Fire Hazard Analysis, Horizontal & Vertical Jet Release, Vapor Cloud Explosion etc. and preparation of Disaster Management Plan for emergency preparedness.

Recently, SRI has successfully accomplished following EIA/EMP Studies:

- EMP/RA study for laying of ATF pipeline
- Rapid EIA and EMP for development of Industrial area
- EIA/EMP for the expansion of Steel Plant
- EIA/EMP for the proposed power plant.

❖ **Studies of STPs/ CETPs/ ETPs**

SRI is regularly providing consultancy services as well as pollution load studies and Evaluation of the Capacity of Effluent Treatment System inclusive of Adequacy Studies.

Recent studies carried out are:-

- Assessment of quantity & quality of effluent discharged in the catchment of CETPs meant for 21-industrial areas in NCT of Delhi.
- Assessment of pollution load and utilization capacities of STPs in 18 towns in NCR in the catchment of river Yamuna for YAP-II.
- Adequacy Studies of ETPs in various industries.

❖ **Rural Water Quality Management**

SRI has signed Long Term Agreement with UNICEF to provide technical services in various areas of Water Quality Monitoring and Purification. Salient features of this programme are:

- Evaluation of Water Quality Field Test Kits to strengthen Community Based Water Quality monitoring & Surveillance Programme in India.
- Efficiency Study of Water Purification Additives.
- Assessment of the effectiveness of Water Purification Filters.
- Evaluation of the Effectiveness of District Water Quality Laboratories in various States of India.
- Participation in the Review Mission for National Rural Drinking Water Quality Monitoring and Surveillance Programme for States.

❖ **Geo-technical and Soil Engineering**

Major thrust areas of this sector are:

- Soil Bearing Capacity Studies based on SPT & PLT.
- California Bearing Ratio Test.

- Assessment of the Shear Parameters of Soil.
- Assessment of Soil Texture & Grain Size Distribution.
- Assessment of the Index Properties of Soil.
- Detailed Investigation of Soil (Physical, Chemical, Micro & Macro Nutrients, Toxic Metals, Hydrocarbons etc.)

❖ **Studies on Municipal Solid Wastes**

SRI provides technical services in the following areas of waste management:-

- Detailed characterization of MSW inclusive of physical segregation, leachates studies, toxicity, corrosivity, ignitability and reactivity.
- Assessment of the Green House Gases formation potential for Carbon Finance Projects.
- Estimation of Landfill Gas for the assessment of the feasibility for Landfill Gas recovery.

❖ **Water Quality Studies**

Provides analytical services to assess the quality of water for:-

- Domestic application inclusive of drinking purposes.
- Industrial applications inclusive of industrial processes, boiler feed, cooling purposes etc.
- Irrigation applicataion.
- Infrastructural use.
- Recreational purposes.

SHRIRAM APPLIED RADIATION CENTRE (SARC)

Shriram Applied Radiation Centre was established in 1986 in collaboration with Bhabha Atomic Research Centre (BARC), Board of Radiation and Isotopes (BRIT), Atomic Energy Regulatory Board (AERB) and Department of Atomic Energy (DAE), Mumbai.

The Division started with Co 60 source of 100 KCi which was gradually upgraded to 200 KCi, 500 KCi respectively and today it has a source strength of 800 KCi. The source is mainly being used for the sterilization and disinfestation of:-

- ❖ Surgical , medical and pharmaceutical products
- ❖ Ayurvedic Medicines
- ❖ Spices and other products
- ❖ Stones and Jewels

Focus Areas of QAD

- ❖ To conduct the inter/ intra laboratory checks and quality checks
- ❖ To participate in proficiency testing programmes and to organise PT programmes for quality analysis / testing
- ❖ To resolve the customer's complaint / observation
- ❖ To collect the customer's feed back in order to strengthen Institute's relations with customers
- ❖ Periodic training and upgradation of competency of personnel
- ❖ Maintenance of quality systems

ACCREDITATION

- ❖ SRI is ISO 9001 certified for its total activities by DNV, The Netherlands.
- ❖ SRI laboratories are accredited by the National Accreditation Board for Testing & Calibration Laboratories (NABL) in the fields of Chemical, Mechanical, Biological and Calibration (thermal, mass, dimension, volume, viscosity, pressure & vacuum).
- ❖ NABL accreditation for on-site calibration (thermal and mass)
- ❖ SARC facility is ISO 13485 and ISO 11137 certified by DNV Netherlands. It is also approved by Atomic Energy Regulatory Board of India, and by the Drug Control Authority, Delhi.
- ❖ The Radiation measurement Laboratory of SARC is accredited by Atomic Energy Regulatory Board (AERB) for measurement of residual radioactive content in commodities.
- ❖ Approval from various State Pollution Control Boards
- ❖ Approval of Environmental laboratories from Ministry of Environment and Forests under Environment Protection Act (EPA)
- ❖ Approval from Central Pollution Control Board for calibration of Ambient Air Monitoring Station on site
- ❖ Approval from Delhi Pollution Control Board for Hazardous Waste
- ❖ In petroleum sector, SRI has special accreditation from:-
 - Director General of Civil Aviation- Aviation fuels
 - Director General of Safety of Mines- Hydraulic fluids

LIST OF IMPORTANT EQUIPMENT

- Gas Chromatographs (GC) equipped with FID, ECD, NPD & TCD detectors, Purge & Trap and Auto Head Space Sampler
- High Performance Liquid Chromatographs equipped with Auto sampler, RI, PDA,UV and Fluorescence Detectors and Gel Permeation Chromatography software
- Liquid Chromatograph/ Mass Spectrometer/ Mass Spectrometer(LC/MS/MS) equipped with Auto Sampler
- Gas Chromatograph / Mass Spectrometer/ Mass Spectrometer (GC/MS/MS) equipped with Auto Sampler
- Atomic Absorption Spectrophotometer (AAS)
- Inductively Coupled Plasma- Optical Emission Spectrophotometer (ICP-OES)
- CHNSO Analyzer equipped with auto sampler
- High Performance Thin Layer Chromatograph (HPTLC)
- UV-Visible Spectrophotometer
- Infra Red Spectrophotometer
- Spectrofluorometer
- Thermo Gravimetric Analyser - Differential Thermal Analyser (TGA-DTA)
- Digital Scanning Calorimeter (DSC)
- Automated Solid Phase Extractor (SPE)
- Microwave Digester
- Turbovap Concentrator
- Universal Tensile Machine
- Melt Flow Index Tester
- Izod Impact Tester
- Heat Distorsion Temperature / Vicat Softening Temperature Apparatus
- Density Gradient Column
- Dart Impact Tester
- NOIR based CO and CO2 Analyser
- Hazdust Monitor
- Noise Analyser System 824
- Hydrocarbon Leak Detector
- Total Hydrocarbon Analyser
- Automatic Weather Station
- Image Analyser
- Coating Thickness Tester
- Universal Tensile Machine for Metals
- Impact Machine for Metals
- Cold Filter Plugging Point
- Four Ball Tester
- Tandelta Resistivity Meter
- Breakdown Voltage Tester Unit
- Foam Indentation Hardness Test Apparatus
- ShoreA/ShoreD Test Apparatus
- De-Matia Flexing Machine
- Viscosity Bath
- Pipe Opacity Tester
- Elmendorf Tear Tester
- IRHD Hardness Tester
- Suntest CPS+
- Atlas UV Condensation
- Xenotest Beta LM
- Oxygen Index Tester
- Smoke Density Test Apparatus
- HCL Gas Generation Test Apparatus
- Flammability Tester
- Toxicity Index Test Apparatus
- A.A.T.C.C Crock Meter
- Bursting Strength Tester (Mulle Type)
- Bursting Strength Tester (Air Pressure Type)
- Bursting Strength Tester (Hydraulic Type)
- Pilling Tester
- Refractometer
- ADPI Scotch Particle Determination
- ALVEO Consistograph
- Water Activity Meter
- Lovibond Tintometer
- Pipe Impact Tester 1 & 2
- Hydraulic Pressure Testing Machine
- Thermal Stability Bath
- Pipe Reversion Bath
- Compression Testing Machine
- Core Cutting Units
- Ultrasonic Pulse Velocity Unit
- Ferrosan
- Stone Polishing Value Machine
- Skid Resistance Tester
- Marshall Stability Unit
- Digital Asphalt Furnace
- Abrasion Machine
- Aggregate Impact Unit
- Heat of Hydration Unit
- WPC/Concrete Permeability Units
- Thermal Conductivity Unit (Refractory)
- Specific Ion Analyser
- X-Rite for Paints