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Cutting-edge R&D of a high order

Of food security: The focus areas of the National Institute for Interdisciplinary Science and Technology in Thiruvananthapuram include agro-processing and biotechnology. — Photo: Reuters

The Regional Research Laboratory in Thiruvananthapuram has transformed into NIIST. It promotes human resource development through scientific training.

In the small State of Kerala, the Regional Research Laboratory in Thiruvananthapuram had been synonymous with scientific research for decades, perhaps for the reason that there were hardly any quality research facilities elsewhere in the State, except for limited opportunities in some university departments.

It was born as the CSIR Complex in 1975 and renamed the Regional Research Laboratory three years later. From 2007, it is known as NIIST — the National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram – 695 019 (ph: [0471] 251 5220; Web: www.niist.res.in).

Though research in this institute has a focus on the effective utilisation of local resources, its current mandate is research and development (R&D) of the highest quality with a broad national perspective. It is endowed with adequate infrastructure in tune with the demands of cutting-edge research under national and international collaboration.

What is significant from the educational standpoint is that NIIST promotes human resource development through scientific training imparted to graduates and postgraduates. Research studies aimed at Ph.D. degrees and post-doctoral research form part and parcel of this prestigious national institute. NIIST is a member of the Academy of Scientific and Innovative Research (AcSIR), which is authorised to award degrees in the frontier areas of R&D.

Major thrust areas

The vital areas of focus are indicated below.

Agro-processing and natural products: process and product development and knowledge generation in the areas of lipid science, spices and flavours, and natural products. The process and product development is not confined to mere academic exercises. It is widely applied in fully engineered technology packages for commercial use to benefit the community. Lipids are any one of a large group of organic compounds that are oily to the touch and insoluble in water, but soluble in non-polar organic solvents. They include fatty acids, oils, waxes, sterols, and triglycerides. They are a source of stored energy.

Exploitation of the herbal wealth of the region.

Chemo and bio-evaluation of herbs and natural products for developing nutraceuticals, phytochemicals, and functional food products. Nutraceuticals are foodstuffs that provide health benefits and nutritional value. Phytochemicals are plant-based chemicals.

Biotechnology: frontier areas of biotechnology exploration and value addition of regional bio-resources, and bioprocess and product development (focus on industrial enzymes, biopolymers, and amino acids).

Energy (bio-fuel) and environment: the work involves developing microbial-based polymers such as polylactic acid and polyhydroxybutyrate using agro residues.

Health and genomics: the department maintains active links with national and international organisations.

Chemical sciences and technology: The division comprises three sections — photosciences and photonics; inorganic and polymeric materials; and organic chemistry.

The main areas of focus are photochemistry and related areas for developing photonic materials for applications in solar-energy harvesting, electro-optical devices, and photo medicine. Design and development of inorganic materials and polymers for applications in areas of energy storage, lighting and molecular sensing for imaging and diagnostics.

Recovery of inorganic chemicals from industrial wastes. Rare earth inorganic pigments. Speciality polymers and polymer composites.

Harnessing the natural wealth (plant and herbal) of the region to obtain novel biologically active compounds or leads for drug synthesis.

Isolation and synthesis of new bioactive molecules and development of state-of-the-art synthetic organic methodologies for the fine chemical industry. (Fine chemicals are complex chemical substances prepared usually in small quantities to a very high degree of purity for use in research and industry).

The division aims at international recognition for excellence in discovering new knowledge on functional materials, natural products, and bioactive molecules for industrial applications.

Materials and minerals: this division stands out by virtue of its remarkable contribution of wide-ranging products to industry. Some of the focus areas of research are nano-ceramics and electronic materials, with emphasis on communication and energy, superconducting and magnetic materials, alloys, and composites.

The following instances of technology transfer speak volumes of its contribution to industry.

Sol-gel based processes developed and transferred for the production of nano-rare-earth phosphates and oxides. Indian Rare Earths Ltd., Kollam, a Union government undertaking under the Department of Atomic Energy, has set up a production plant based on this innovation.

Nano-titanium-oxide-coated ceramic tiles with self-cleaning and anti-algal properties have been developed. They are being transferred to industry.

BHEL has set up a plant in Bangalore based on titanium-oxide ultra-filtration membranes for industrial water recycling.

Processes for fly ash, red mud, and new clay mixes have been transferred to various industries.

Environment-friendly technology for synthetic rutile from beach sand mineral ilmenite.

Apart from these, the division has developed materials and components, such as high-strength aluminium and magnesium alloys with considerable grain refinement for space and defence applications. The superconducting and magnetic materials group has fabricated long-length high Tc wires and tapes for cryogen-free magnets and fusion magnets. The electronic ceramic group has developed new and efficient materials for microwave communication and also for energy. Characterisation and processing of “beach sand minerals” for value-added products is another area of study.

Process engineering and environmental technology: the division has four sections. The main thrust in each department is indicated below.

Environmental Technology: Development of processes for odour control, anaerobic treatment for solid-waste treatment, industrial water purification, and activities related to environment impact assessment

Computational modelling and simulation: development of software tools for casting in foundries, modelling of chemical reactions, rotary kiln reactors, and works related to rational design of molecules and materials

Chemical and process engineering: development of mineral beneficiation flow sheets. Reverse flow dryers for the

rural sector.

Dioxin research: monitoring, control, and phasing out of “persistent organic pollutants,” with special reference to dioxins and furans from various industrial and non-industrial activities. Dioxin is toxic heterocyclic hydrocarbon that occurs especially as a by-product of industrial processes such as pesticide manufacture or garbage incineration.

Some of the landmark contributions include software for casting simulation, or ‘virtual casting,' and simulation of micro porosity in aluminium castings for General Motors, U.S.; odour-control plants in rubber and fish-meal factories using gas bio-filter technology; anaerobic leach-bed technology for production of white pepper; simulation for rotary kiln for manufacture of synthetic rutile; and reverse flow dryers for agro-based products.

NIIST endeavours to fulfil its vision of social commitment through scientific interventions. Green Enterprises for Micro-Sector, which aims at environment-friendly applications of technologies for the benefit of low-income groups, is a case in point.

Aspirants for scientific research will find an encouraging atmosphere in the institute.