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ATIRA RESEARCH & INNOVATION QUARTERLY

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DIRECTOR'S MESSAGE

FROM IDEAS TO IMPACT ATIRA'S NEW CHAPTER IN KNOWLEDGE SHARING

For more than seven decades, ATIRA has been a quiet but decisive force behind India's progress in textiles and materials. From conventional textiles to today's high-performance technical domains, our work has consistently shifted industries forward, often before the market fully recognised the need.

Today, India is entering a phase where **innovation is no longer optional, it is national infrastructure.** Technical textiles, advanced materials, composites, smart systems, sustainability frameworks, and quality assurance platforms are becoming central to India's competitiveness in defence, space, mobility, infrastructure, healthcare and beyond.

In this environment, ATIRA's responsibility is clear, **we must move from being only a research institution to being a knowledge engine for the nation.**

This publication is a step in that direction. It is designed to:

- **Translate science into strategy,** turning our research outcomes into insights that the industry can apply immediately.
- **Make innovation visible,** showcasing the work done at our centres, laboratories, and partner ecosystems.
- **Build shared intelligence,** connecting researchers, entrepreneurs, manufacturers, students, and policymakers through a common understanding of where the future is heading.

This newsletter is not just an update. It is ATIRA's commitment to **lead the conversation** on the future of materials and technical textiles. A future where India innovates for itself and for the world.

As you read this edition, I invite you to see ATIRA not only as a testing and research institution, but as a collaboration platform, one where ideas, people, and capabilities converge to create tangible impact.

Knowledge moves industries. Shared knowledge moves nations. Let us move forward together.

PRAGNESH SHAH
Director, ATIRA

THOUGHT LEADERSHIP NATIONAL TECHNICAL TEXTILES MISSION

Ashok Kumar Malhotra
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National Technical Textiles Mission: Building India's Future through Innovation, Collaboration, and Scale

India stands at the cusp of a new era in textiles, one defined by technology, sustainability, and innovation. The National Technical Textiles Mission (NTTM), launched in 2020 with an outlay of ₹1,480 Crore, is driving this transformation with a vision to position India as a global leader in technical textiles.

Over the past few years, the Mission has supported over 150 research and innovation projects and has strengthened collaboration between research institutions, academia, and industry to accelerate development and commercialization of advanced textile technologies. To build human capital, 45 institutes across India have been supported in introducing technical textile curricula at undergraduate and postgraduate levels, ensuring that the next generation of professionals is equipped with the knowledge and skills to lead this evolving sector.

Additionally, 16 short-term skilling courses have been designed and implemented to enhance practical competence, while 24 start-ups have been supported on a pan-India basis, encouraging entrepreneurship and innovation in new materials, smart textiles, and sustainable solutions.

The Mission is also advancing indigenous technology development to reinforce India's manufacturing capabilities. New machines such as air-jet looms, circular weaving systems, and advanced testing equipment are under development, with several already transferred to industry for commercial production. These initiatives represent major progress toward technological self-reliance and global competitiveness.

As we look ahead, it is essential that we join hands to identify and solve the real challenges faced by our industry. Our research must be purpose-driven, focused on addressing problem areas, improving functionality, and enhancing user experience. We must also ensure that India adopts global standards and develops products that can compete confidently in international markets, recognized for their quality, sustainability, and innovation.

Equally important is integrating functional and sustainable textiles into mainstream markets to enhance both utility and novelty. Imagine fire-retardant tents for defence and disaster response, flame-retardant bed linens for hospitals and hospitality, or insect-repellent clothing for agricultural and field workers. These innovations demonstrate how textiles can improve safety, comfort, and environmental responsibility while creating new market opportunities. Over the past few years, NTTM has made significant progress in shaping a vibrant ecosystem that connects government policy, industry dynamism, and institutional research.

ATIRA's relaunch of its publication comes at a truly opportune moment. It will serve as a vibrant platform for knowledge sharing, collaboration, and inspiration, connecting government, industry, academia, and start-ups to accelerate India's leadership in technical textiles.

Together, let us build a future where India's textiles are celebrated not only for their beauty and heritage, but also for their innovation, sustainability, and global impact - Our journey continues until India becomes truly Atmanirbhar.

ATIRA R&D SPOTLIGHT
COMPOSITE ANTENNA FOR AEROSPACE

ADVANCING LIGHTWEIGHT, HIGH-PERFORMANCE RF SYSTEMS THROUGH CFRP & NANOTECHNOLOGY

Dharmesh Rizwani
Center of Excellence for Composites - ATIRA

Composite antennas are emerging as a viable and high-performance alternative to conventional metallic antennas, particularly in aerospace platforms where weight, corrosion resistance, and manufacturability directly influence mission efficiency. At ATIRA, ongoing work is focused on the development of **carbon fiber reinforced polymer (CFRP)**–based slotted waveguide antennas, engineered to achieve metallic-grade electrical performance while retaining the mechanical advantages of composite materials.

Our approach integrates **graphene-based conductive inks** and **copper electroplating** to introduce high surface conductivity, enabling CFRP antennas to meet the stringent RF requirements of aerospace communication systems. This case study outlines the design considerations, fabrication strategy, metallization challenges, and recent breakthroughs at ATIRA toward scalable, reliable composite antenna technologies.

Why Composite Antennas Matter

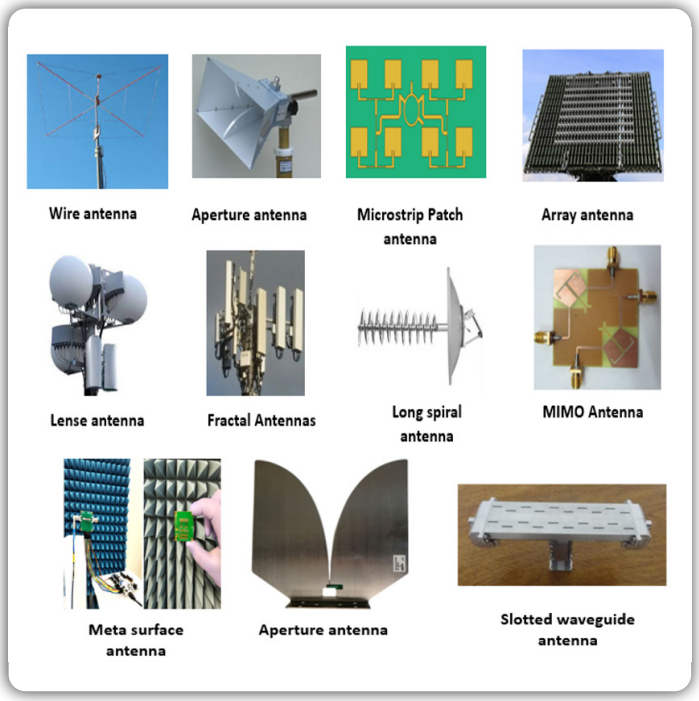
Antennas are essential for communication, navigation, and radar systems; however, conventional metal antennas present well-known limitations in advanced aerospace environments:

- High mass, leading to reduced fuel efficiency
- Corrosion susceptibility in harsh atmospheres
- Limited conformability in aerodynamic structures

CFRP composites address these issues through:

- 30% weight reduction compared to aluminum
- High thermal stability (–150 °C to +150 °C)
- Low CTE (Coefficient of Thermal Expansion) and superior vibration damping
- Compatibility with conformal and integrated structures

The challenge: CFRP is inherently electrically insulating. Achieving antenna-grade conductivity (~10^6–10^7 S/m) requires engineered surface metallization - A central focus of ATIRA's research.



CFRP Antennas: Technical, Commercial & Strategic Relevance

Technical Advantage - Advanced surface engineering (graphene inks, electroplating, plasma activation) enables CFRP antennas to rival metal antennas in:

- **RF conductivity**
- **Radiation performance**
- **Structural robustness**
- **Thermal/vibration behavior**

Commercial Advantage - Weight reduction directly translates to:

- **Lower operating costs**
- **Higher payload efficiency**
- **Extended range**

As global OEMs increasingly adopt CFRP for aero-structures, antenna development becomes a natural extension.

National Strategic Advantage - India's growing programs—HAL aerospace platforms, DRDO radar systems, ISRO missions, and emerging 5G/6G infrastructure—create a significant need for indigenous, high-performance antenna technologies aligned with Atmanirbhar Bharat. ATIRA's work directly contributes to this national priority of RF technology self-reliance.

Slotted Waveguide Antennas: A Composite Perspective

Slotted waveguide antennas consist of a waveguide body with engineered slots that radiate electromagnetic energy. They offer:

- Compact form factor
- High efficiency
- Suitable for aircraft and satellite structures
- Microwave frequencies (300 MHz–300 GHz)

Key Features

Structure: Slots on broad/narrow waveguide walls

Working Principle: Slot geometry defines polarization, beam direction, and gain

Benefit: Conformal, lightweight integration when fabricated with CFRP

Why Composites Instead of Metals?

CFRP waveguides provide:

1. 30% weight savings
2. Structural compatibility with airframes
3. Improved environmental durability
4. Freedom to design complex, conformal antenna geometries

The remaining technical barrier is **conductivity**, addressed through engineered metallization systems.

Introducing High Conductivity in CFRP Structures

ATIRA is evaluating and optimizing several metallization strategies:

Conductive Inks

Graphene, silver nanoparticles, CNT-based formulations

High filler loading enabled through acrylic binders

Challenges include viscosity control, surface uniformity, and curing behavior

CVD/PVD Metal Layers

Ultra-thin metallic coatings

Limited adhesion on CFRP without surface activation

Plasma Surface Treatment

Improves surface energy

Enhances adhesion for inks and electroplated layers

Seed Layer + Copper Electroplating

Conductive ink applied as a seed

Copper electroplated to achieve >10^6 S/m

Delivers metallic-like RF performance with composite weight advantages

Metallic Foil Lamination

Lightweight foils bonded to CFRP

Risk of delamination during thermal cycling

Recent Progress at ATIRA

- ATIRA has successfully fabricated CFRP waveguide prototypes and related testing is in progress.
- Achieved high conductivity suitable for aerospace grade RF applications
- Development work is in pathway for scalable, automated composite antenna fabrication

This work is supported by ATIRA's capability in **advancedcomposites, surface engineering, and RF validation**, positioning the institution as a key contributor to India's emerging composite-based antenna ecosystem.

Applications & Future Directions

Composite antennas developed at ATIRA can significantly impact:

Aerospace & Defence
Lightweight radar/ communication systems

Telecommunications
High-efficiency microwave links

Smart Mobility
Integrated RF systems

Medical Platforms
Compact diagnostic RF modules

Near-term R&D priorities include:

Integration of next-generation nanomaterials

Automated metallization and scalable fabrication

Accelerated aging & reliability testing (ASTM)

Conclusion

CFRP-based antennas enhanced through nanotechnology represent a high-performance alternative to metal antennas for next-generation aerospace and communication systems. ATIRA's work demonstrates that with advanced surface engineering, composite antennas can deliver aerospace-grade RF behavior while achieving substantial weight savings, thus supporting India's strategic objectives in defence, space, and telecom sectors.

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TESTING, STANDARDS & QUALITY

STRENGTHENING INDIA'S NATIONAL QUALITY INFRASTRUCTURE THROUGH ATIRA'S TESTING & CONFORMITY ASSESSMENT

Ms. Deepali Plawat
Senior Deputy Director, ATIRA.

India's aspiration to become a leading global manufacturing and sourcing hub under the Make in India initiative rests fundamentally on the robustness of its **National Quality Infrastructure (NQI)**. Our ambitious target of textile and apparel export value of USD 100 billion by 2030, places quality assurance at the centre of our industrial policy. As Indian industry scales up across textiles, technical textiles and advanced materials, the ability to demonstrate compliance with harmonised standards, ensure product safety, and validate performance under real-world conditions becomes central to export competitiveness, infrastructure reliability and consumer confidence.

The Government of **India's National Technical Textiles Mission (NTTM)** under Ministry of Textiles has clearly articulated the need for strengthening testing, certification and standards development as a prerequisite for the growth of high-performance textile segments. In parallel, the expanding universe of BIS Quality Control Orders (QCOs) reflects a policy shift toward quality-led manufacturing and market entry based on verified conformity rather than post-market correction.

In this evolving policy landscape, ATIRA functions as a critical institutional pillar supporting the nation's quality and standards ecosystem.

ATIRA's Institutional Role within the Quality Framework

As a national textile research institute with **NABL-accredited laboratories**, ATIRA operates in close alignment with the **Quality Council of India (QCI)** framework and BIS regulatory mechanisms. Our mandate extends beyond routine testing services to include **enabling policy implementation, regulatory compliance and capacity** building across industry and infrastructure agencies. ATIRA thus functions as a **technical extension of India's quality and standards ecosystem** supporting regulators, industry and implementing agencies in translating policy intent into measurable compliance outcomes.

ATIRA's testing ecosystem spans entire range of conventional textiles, technical textiles, composites, chemicals and environmental parameters, providing structured conformity assessment support aligned to both domestic regulations and internationally harmonised ISO standards critical to public safety, infrastructure longevity and sustainability compliance. Our specialised capabilities across **Geotech, Protech, Composites, Indutech, Agrotech, Autotech, Packtech and Meditech** are designed to support sectors identified as priorities under NTTM and related national programmes. Faster turnaround times, high measurement confidence and continuous test parameter expansion reflect our focus on systemic quality strengthening rather than episodic testing.

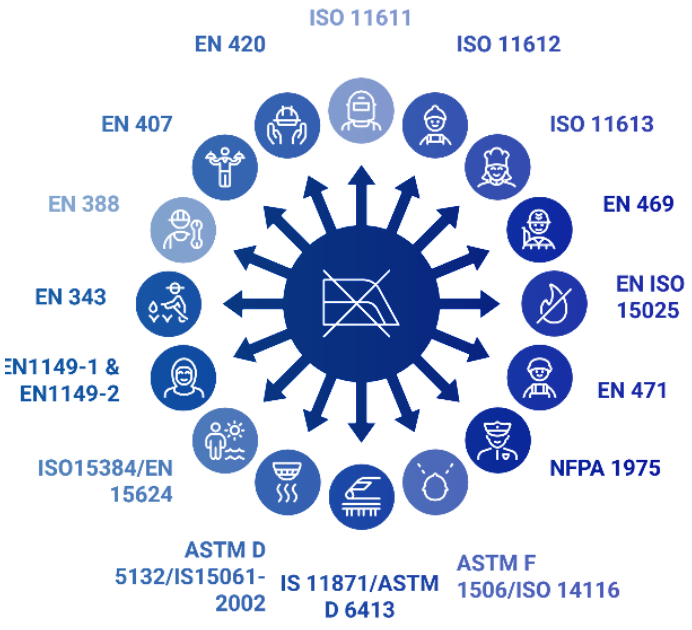
Supporting Strategic and Public Infrastructure Sectors through ATIRA's Testing Ecosystem

Advanced Composite Materials and Mobility Systems

In support of national initiatives for modern rail, urban transport and advanced mobility platforms, ATIRA has expanded its composite and fire performance testing capabilities for high-speed mass transportation systems, including Vande Bharat. In alignment with emerging applications identified under Make in India and defence-linked manufacturing, ATIRA has developed over **40 additional test parameters** addressing drones, composite rebars and advanced structural components.

ATIRA is empanelled with national and municipal agencies for **Cured-In-Place Pipe (CIPP)** liner testing, GRP liner evaluation for sewage infrastructure, and **RDSO-approved heat and flame testing,** contributing directly to safety assurance and lifecycle performance of public assets.Protective Textiles and Occupational Safety Protective textiles directly impact worker safety, emergency preparedness and national resilience.

ATIRA is empanelled by **BIS for 11 out of 12 QCOs** relating to protective textile products and provides comprehensive testing support for fire-retardant garments, fire entry suits, aramid-based materials, camouflage systems and protective gloves. These capabilities strengthen regulatory enforcement while enabling manufacturers to achieve compliance in a predictable and time-bound manner.



Geotextiles and Infrastructure Quality Assurance

Geotextiles represent a foundational component of sustainable infrastructure development under national programmes for roads, railways, flood control and river management. Given the scale of public investment in such projects, **standard-compliant testing is essential to ensure performance integrity and value for money.**

ATIRA is accredited by **BIS for ALL the geotextile related Quality Control Orders** and offers testing across **more than 30 parameters** covering geomembranes, geocells, geogrids, geosynthetics, polymer gabions and related products. ATIRA is empanelled with organisations funded by ADB for their projects, various state public works, roads & building and water resource departments, reinforcing its role in nationally significant infrastructure assurance.

Environmental Compliance

Environmental compliance has become integral to both trade policy and domestic regulatory regimes. ATIRA's **Ecology Testing Laboratory** supports implementation of sustainability norms through analysis of trace metals and restricted substances, including APEO, chlorophenols, carcinogenic and allergenic dyes, and pesticide residues facilitating industry alignment with global environmental benchmarks.

In parallel, ATIRA supports transparency and credibility in India's cotton ecosystem. Its empanelment with **TEXPROCIL for Kasturi Cotton testing,** role as **primary assayer for MCX,** empanelment with **BIS** and function as an **independent assayer for BSE** reflects its institutional responsibility to market integrity and stakeholder confidence.

Future-Focused Capability Development Aligned with Global Standards

In line with NTTM's emphasis on future-ready testing infrastructure, ATIRA is commissioning advanced capabilities in **Particulate Filtration Efficiency testing,** introducing globally aligned ISO testing protocols within India.

ATIRA now offers complete air filter performance evaluation as per **ISO 16890** for general ventilation across industrial, commercial and healthcare applications.

Additionally, **HEPA filter and filter media testing as per ISO 29463** supports ultra-clean environments critical for ICUs, pharmaceuticals, biotechnology, aerospace, electronics and food processing sectors.

Conclusion

Testing and conformity assessment forms the backbone of a credible and globally aligned manufacturing economy. As India strengthens its National Quality Infrastructure under Make in India, NTTM and QCI-led frameworks, ATIRA serves as an essential enabler translating policy intent into measurable, enforceable and trusted quality outcomes.

From the Office of the Senior Deputy Director, ATIRA reaffirms its commitment to supporting regulators, industry and implementing agencies in building a **quality-led**, **resilient and globally competitive manufacturing ecosystem.** As ATIRA enters its 78th year of service, this commitment remains central to our institutional mission!

CARBON FIBRE WEAVING

INNOVATIONS IN CARBON COMPOSITES AND HIGH-PERFORMANCE MATERIALS

Dr Ashwin Thakkar
Consultant, ATIRA

Carbon fibre exhibits excellent properties. These include light weight, high strength, high modulus, corrosion resistance, low thermal expansion, fatigue resistance, and good biocompatibility. CFRP, composite materials reinforced with carbon fibre fabrics, are regarded as advanced high-tech products. They are widely used in sports equipment, construction reinforcement, transportation, aerospace, and other fields. Due to their outstanding performance, carbon fibres and their fabrics have become essential materials for countries worldwide.

Woven carbon fibre fabrics are preferred for their strength-to-weight ratio, stiffness, and corrosion resistance. They offer design flexibility, making them ideal for high-performance aerospace, automotive, and sports gear. The woven structure gives toughness and drapability. It allows for multidirectional strength and makes shaping curves easy without adding bulk.

Main Problems in Carbon Fibre Weaving

Carbon fibre weaving faces major problems due to the fibre's inherent brittleness, high friction, and low toughness, causing yarn breakage, fuzzing, and high material loss. Higher brittleness is due to the fact that layers in the fibres are formed by strong covalent bonds. The sheet-like aggregations readily allow the propagation of cracks. When the fibres bend, they fail at very low strain. Research has shown that during the guiding process, the loss rate of carbon fibres can reach up to 7%–8%. With some changes like special looms, tension/friction control, and cushioning, fibre damage can be minimised, and it will be possible to maintain the final composite's mechanical integrity. Key issues include excessive abrasion on loom parts, tension spikes during shedding, and yarn damage that compromises the final product's strength and integrity.

- Carbon fibres are strong but brittle; high friction with machine parts or other yarns causes fuzzing (broken filaments) and snap-offs, leading to defects. Contact with loom components, such as temples, rollers, and needles, also creates wear, damaging fibres and reducing their strength.
- Tension Fluctuations: Cyclic tension changes during shedding and take-up motions stress the fibres, increasing breakage rates.
- Process Incompatibility: Traditional weaving methods aren't suited for carbon fibre; standard processes like sizing are often unsuitable, necessitating modified approaches.

Problems in carbon fibre weaving can lead to significant defects in the final composite material, primarily fibre misalignment (wrinkling and waviness), which drastically reduces the composite's strength, modulus, and structural stability, and can also lead to secondary defects like voids and delamination. The mechanical process of weaving can cause abrasion and breakage of the individual carbon filaments, especially if proper handling procedures and equipment modifications are not used. These tiny surface flaws act as stress concentration points, initiating cracks and leading to premature failure.

Irregular fibre packing, caused by misaligned or staggered fibre bundles, results in localized areas with too much or too little resin. Resin-rich areas are weak points prone to cracking, while resin-starved areas (voids) lead to weak bonding and poor load transfer between the fibre and matrix.

While delamination can occur in service, it is often initiated by manufacturing defects. Weaving issues that create weak interfaces or localized stress can lead to layers of the composite separating, which

significantly reduces the material's structural integrity.

Overall Impact on the Composite may be Reduced Mechanical Performance, Unpredictable Failure and Increased Manufacturing Costs

Solutions & Adaptations

- Pretreatment: Before weaving, carbon fiber needs to undergo pretreatment to enhance its weaveability and reduce damage during the weaving process. The pretreatment technology mainly involves impregnating a sizing agent to form a soft and tough sizing film, which enhances the bonding capability of the fibers and improves their physical properties.
- Modified Machinery: Using specialised looms, integrated warp preparation, and positive let-off systems will lead to slightly improved performance. When weaving with carbon fibres, due to their unique properties, the conventional warping process is often omitted. Instead, a creel and tension control device is added — the carbon fibres are drawn from the creel through the tensioner to adjust the tension — thereby improving weaving efficiency and reducing fibre loss.
- Cushioned Surfaces: Adding cushioning to loom parts (rollers, etc.) to reduce abrasion.
- Process Control: Optimising tension, reducing bending depth, and modifying contact surfaces. Usually, rigid rapier looms are preferred for weaving carbon fibres. A weaving speed of about 180 to 200 may be considered better. A relative humidity of about 40 – 50% has been found to give optimum results.
- Specialised Techniques: Developing methods like 3D weaving, modified warp preparation, and even fibre modification (e.g., surfactants) to improve wear resistance.
- Advanced Inspection: Controlling the quality of the raw carbon fibre fabric through advanced inspection methods, such as machine vision systems, is crucial to mitigating these problems and ensuring a reliable final product.

By addressing these challenges, manufacturers can create high-quality carbon fibre fabrics, crucial for aerospace, automotive, and other advanced composites.

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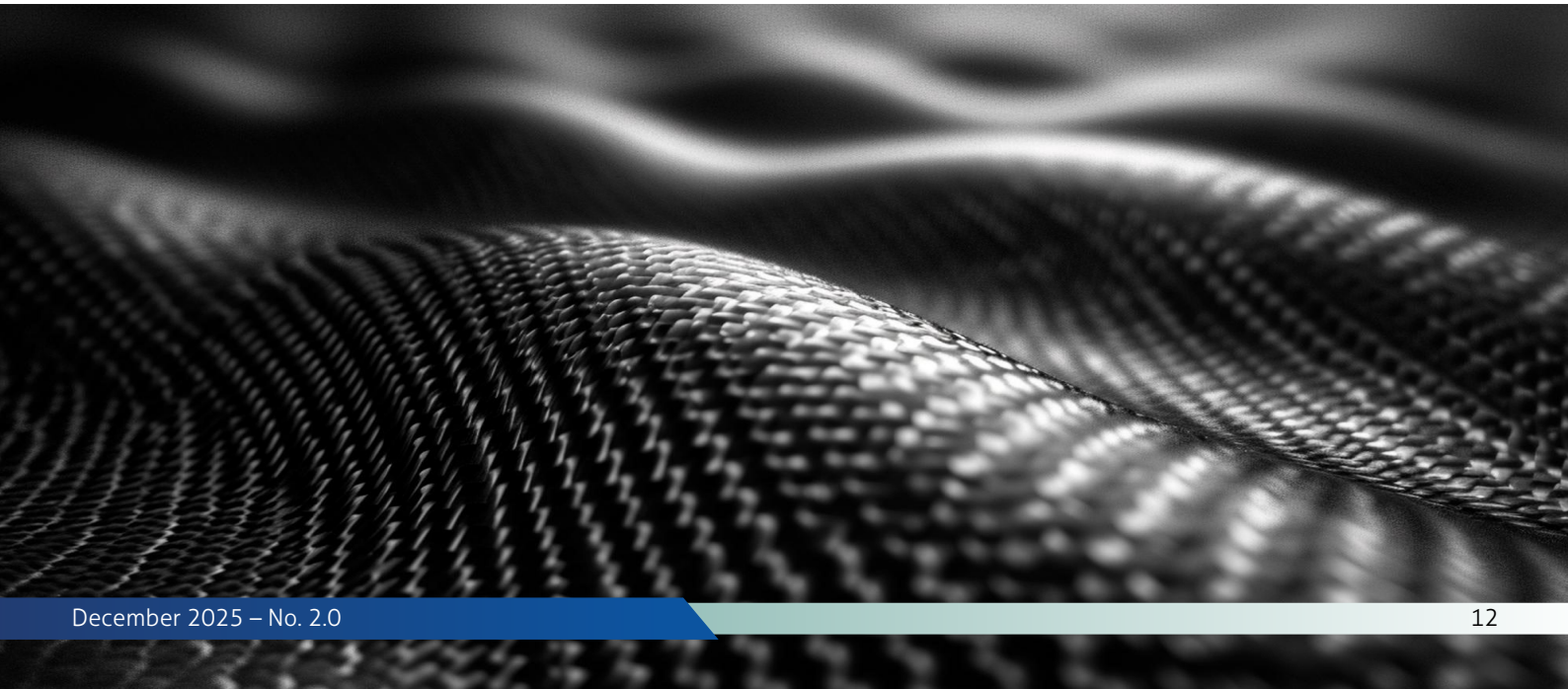


TECHNOLOGY & INNOVATION

AI FOR ORGANIZATIONS: WHAT EVERY BUSINESS SHOULD KNOW

Manish Gopalani
Head, IT, ATIRA

Artificial Intelligence (AI) is the technology that allows machines and software to perform tasks that usually require human intelligence. These tasks include learning from data, understanding language, recognizing images, making decisions, and predicting outcomes.

1. What is AI ?

- AI is a computer system that can "think" and "learn" like a human.
- It can analyse data, recognize patterns, and take actions based on its learning.
- AI can be narrow (specialized in one task) or general (can perform multiple tasks)

Department	AI Application	Benefit
Customer Service	Chatbots that handle queries 24/7	Faster responses, reduced cost
Sales & Marketing	Predicts customer preferences	Personalized recommendations, higher sales
Human Resources	Resume screening and candidate matching	Saves time, improves hiring quality
Operations	Predictive maintenance	Reduces downtime and repair costs
Finance	Fraud detection systems	Increased security and compliance

3. Benefits of AI in Organizations

- **Efficiency:** Automates repetitive tasks, allowing employees to focus on higher-value work.
- **Cost Savings:** Reduces operational costs through automation and predictive insights.
- **Better Decision-Making:** AI analyzes large amounts of data faster than humans.
- **Improved Customer Experience:** Personalizes services and provides instant support.
- **Innovation:** Helps create new products, services, and business models

4. Challenges in Adoption of AI

- **Data Quality:** AI needs accurate and clean data to work effectively.
- **Skills Gap:** Employees may need training to work with AI tools.
- **Cost of Implementation:** AI projects can require investment in software, hardware, and talent.
- **Ethical Considerations:** AI decisions must be fair, transparent, and unbiased.

5. Steps for Organizations to Start Using AI

- Identify business problems AI can solve.
- Collect and organize relevant data.
- Start with small pilot projects.
- Measure results and refine AI models.
- Scale successful AI solutions across the organization.

6. Future of AI in Organizations

- AI will become part of everyday operations.
- Collaboration between humans and AI will increase productivity.
- Smarter AI tools will help organizations make better decisions faster.

Key Takeaway

- AI is not just a futuristic concept, it's a practical tool to improve efficiency, reduce costs, and enhance decision-making
- AI is not just technology any Organisation can use AI to work smarter, save time and money, and provide better services. The key is starting small, measuring results, and scaling gradually.

 # Next Topic : AI Tools for Better Efficiency at work [To be continued up coming newsletter]

ATIRA CENTRE OF EXCELLENCE FOR COMPOSITES

DRIVING INDIA'S FUTURE IN ADVANCED MATERIALS, LIGHTWEIGHT STRUCTURES & HIGH-PERFORMANCE MANUFACTURING

The demand for lightweight, high-strength, corrosion-resistant, and multifunctional materials has accelerated across sectors such as aerospace, defence, mobility, infrastructure, renewable energy, and smart systems. As India expands its ambitions in these strategic domains, the need for indigenous composite materials, processing know-how, and testing capabilities has become critical.

The **Centre of Excellence for Composites at ATIRA** is one of India's foremost hubs dedicated to the research, development, testing, and industrial translation of advanced composite materials. Built with the support of national missions and strategic industry partners, the CoE

has evolved into a state-of-the-art platform that spans **design, processing, prototyping, testing, validation, and technology demonstration and pilot manufacturing**.

Integrated Capability Across the Composites Value Chain

Unlike traditional labs focused on isolated processes, ATIRA's CoE provides a **full-stack ecosystem** that covers:

Material Development & Characterization

- Fibre systems: glass, carbon, basalt, natural fibres
- Resin systems: epoxy, vinyl ester, high-temperature resins
- Nanomaterial integration for conductivity, flame-retardancy, impact resistance
- Mechanical, thermal, and environmental testing of composites
- Microstructural analysis and failure mechanics

This enables ATIRA to engineer materials that meet demanding requirements for **defence, EV components, aerospace structures, rail applications, infrastructure and industrial systems.**

Advanced Processing Infrastructure

The CoE features **industrial-grade equipment** enabling both prototyping and pilot manufacturing. Key capabilities include:

Robotic 3D Radial Braiding System

A flagship capability that positions ATIRA among the few institutions in India able to produce:

- Cylindrical and complex braided preforms
- Torsion-resistant components
- Lightweight structural tubes
- Composite reinforcements for defence & space

This facility supports design freedom, repeatability, and the ability to create shapes that traditional weaving or filament winding cannot achieve.

Pultrusion Line

For continuous manufacture of:

- Structural profiles
- Electrical and infrastructure components

ATIRA also runs **NSQF-aligned operator training**, helping the industry close its workforce skill gap.

Vacuum Infusion & Compression Molding Suites

Enabling:

- Aerospace-grade laminates
- High-strength monolithic and sandwich structures
- Prototype components for automotive and mobility applications

Solvent impregnation machine for manufacturing prepregs

- Glass-phenolic, Carbon-epoxy and other solvent based prepregs for insulation, ablative applications

Upcoming Infrastructure

- **Aerospace-grade autoclave** (commissioning in 2026)
- **Cleanroom facility of class 10000 and class 100000** for precision composite fabrication

These upgrades will position ATIRA as a **national node for high-precision composite manufacturing.**

Testing, Validation & Certification

The CoE houses an extensive range of testing capabilities, strengthened significantly over the last two years:

- Tensile, flexural, interlaminar shear, impact, fatigue
- Composite fire testing (including flame spread and heat release)
- Resin chemistry and cure profiling
- Drone-grade materials testing
- Dimensional inspection and NDT support

More than **40 new test parameters** were added recently, enabling ATIRA to support complex **certification programs for rail, defence, mobility, aerospace, and renewable energy.**

Applied Research & Technology Development

ATIRA's CoE has contributed to several pioneering national programs:

Aerospace & Defence

- Composite radomes and reflectors
- Slotted waveguide antenna development (CFRP-based)
- EMI-shielded composite structures
- High-temperature composite housings

Rail & Mobility

- GFRP profiles for high-speed rail
- Lightweight EV structural components
- Composite-to-metal substitution studies

Energy & Infrastructure

- High-durability composite rebars
- Corrosion-resistant profiles for bridges, towers, and marine applications

These projects demonstrate ATIRA's ability to transition from R&D to real-world industrial implementation.

Industry Training & Capacity Building

The CoE plays a national role in composites skilling through:

- Pultrusion operator training program from 8-12-2025 to 10-02-2026
- Composite fabrication workshops
- Testing and standards courses
  - Composite material Testing from 05-01-2026 to 22-01-2026
  - Heat & Flame Testing of Composites from 02-02-2026 to 19-02-2026
- Hands-on internships for engineering students under NTTM

These initiatives strengthen India's emerging composite manufacturing workforce and ensure alignment with global best practices.

Startup Support & Innovation Ecosystem

ATIRA's CoE actively supports technology driven startups under the NTTM GREAT Scheme. Startups currently incubating work on:

- Graphene-based smart textiles
- Advanced braided composites
- Novel radome-IFF integrated structures
- Deployable space antennas using shape memory composites

This ecosystem accelerates India's transition toward **indigenous, IP-led innovation** in advanced materials.

Strategic Impact

The CoE for Composites is not just a laboratory it is a strategic enabler for India's national missions:

- **Atmanirbhar Bharat** in defence and aerospace
- **Energy efficiency** through lightweight mobility components
- **Infrastructure modernization** with corrosion resistant materials
- **Emerging technologies** such as UAVs, space systems, defence components and smart mobility

By integrating research, industry collaboration, testing, and talent development, ATIRA is building one of India's strongest platforms for advanced composite innovation.

The Centre of Excellence for Composites reinforces ATIRA's position as a **national leader in advanced material systems,** driving innovation from concept to proof of performance. As industry demand accelerates, the CoE is committed to supporting India's journey toward **globally competitive, technology-driven manufacturing** in composites.

INDUSTRY CASE STUDIES

CASE STUDY: ADVANCED CONDUCTIVE COMPOSITE MATERIALS FOR DEFENCE: ENGINEERING THE NEXT WAVE OF ELECTROMAGNETIC STRUCTURES

Modern defence platforms—whether airborne, naval or land-based—depend increasingly on materials that combine structural performance with precise electromagnetic characteristics. Composite materials have become essential for antennas, radomes, and EMI-shielding components in radar and communication systems.

ATIRA is developing a new class of conductive composite structures for defence applications in collaboration with a national defence R&D organization. This builds upon ATIRA's solid track record in engineering radomes, reflectors, and RF-transparent composite structures that meet stringent performance and environmental requirements.

Technical Challenge

Conventional composites are electrically insulating. Defence antennas and EM structures require controlled conductivity or selective transparency. ATIRA is addressing this through:

- Graphene-based and nano-silver conductive layers
- Surface activation and plasma treatment for improved adhesion
- Hybrid CFRP skins with engineered conductivity gradients
- Copper electroplating on seeded composite substrates

These approaches enable conductivity levels in the range required for **stealth surfaces, EMI shielding, and broadband antenna performance,** while retaining the structural advantages of CFRP.

Prototype Development

ATIRA's team is developing **conductive composite panels and antenna housings** capable of:

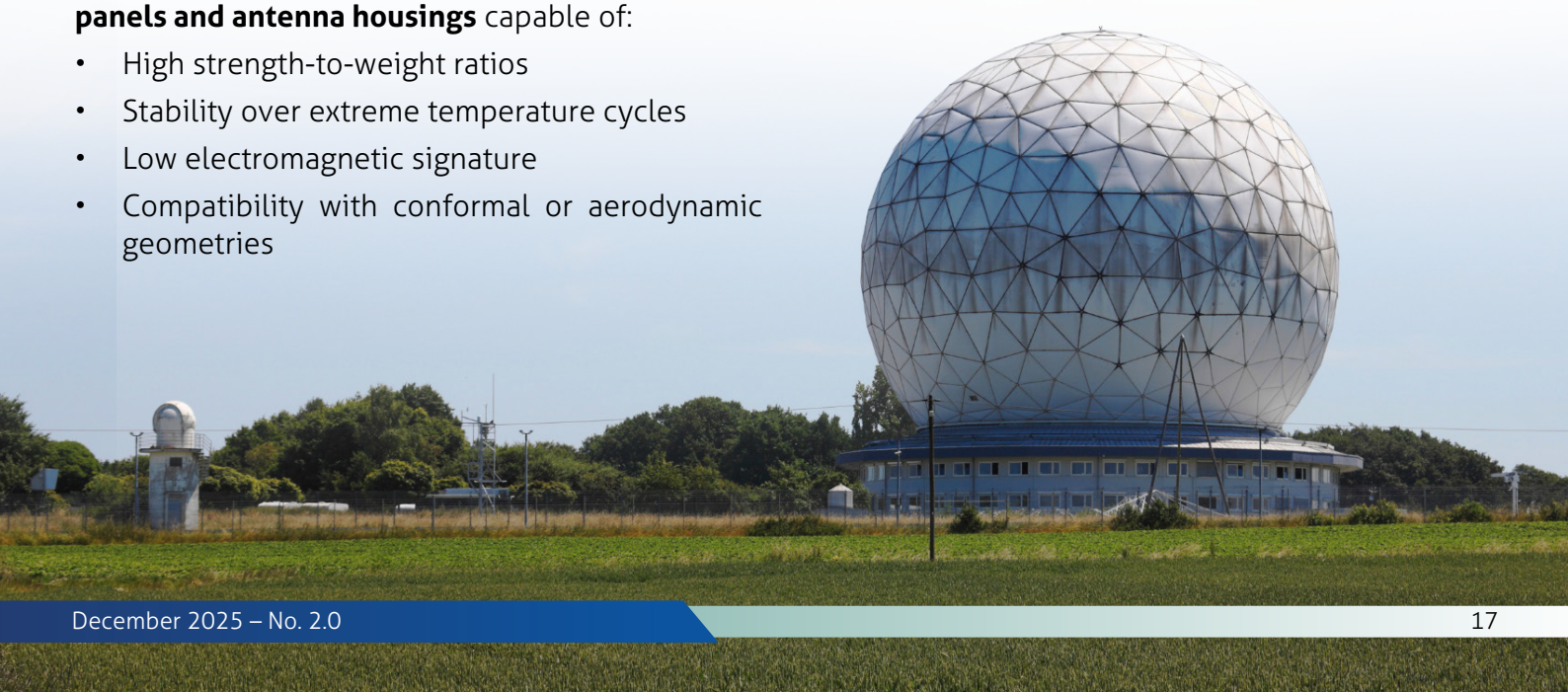
- High strength-to-weight ratios
- Stability over extreme temperature cycles
- Low electromagnetic signature
- Compatibility with conformal or aerodynamic geometries

Mechanical and RF testing is conducted in ATIRA's upgraded labs, which now support evaluations for **drone components, high-temperature resins, structural composites, fire performance, and RF-critical applications.**

Strategic Relevance

With India's growing emphasis on indigenous technologies under Aatmanirbhar Bharat, locally developed EM-grade composites are a strategic enabler. These materials reduce import dependency, shorten development cycles, and create new capabilities for aerospace, missile systems, surveillance platforms, and secure communication networks.

ATIRA's research demonstrates how materials innovation can meaningfully strengthen India's defence ecosystem while opening export opportunities in high-value global markets.



Internship and Incubation Centre Innovation in Motion at ATIRA

ATIRA successfully concluded the NTTM (National Technical Textiles Mission) Internship Program under the GIST (Graduates in Technical Textiles) initiative. This year's program brought together 31 talented students from premier institutes across India, each contributing unique ideas and technical expertise to shape the future of technical textiles. The diversity of academic backgrounds encouraged collaboration and innovation, creating a dynamic environment for applied textile research.

Participating Institutions

- NIT Jalandhar
- Nirma University
- Pandit Deendayal Petroleum University (PDPU)
- NIFT Bangalore
- NIFT Mumbai
- JNLU (Jivaji National Law University)
- Ahmedabad University
- Osmania University

Focus Areas of the Internship

Under expert mentorship from ATIRA's scientists and engineers, students explored:

- Composite Testing
- Technical Textiles Laboratory (TTL) Analysis
- Geotextile Applications

Incubation Projects in Technical Textiles

These projects provided hands-on industry exposure, blending research with innovation and problem-solving aligned with NTTM's national mission.

Workshops

The Composites Testing Laboratory also conducted intensive internship programs for students from PDEU, NIT Jalandhar, and JNIT, Himachal Pradesh.

Key Learning Areas

- Testing and evaluation of composite materials
- Analysis of mechanical and physical properties
- Fire-retardancy behavior in composite systems

Students also developed their own materials — combining innovation with sustainability.

Project Highlights

PDEU Students: Developed FRP tubes using plant-based natural fibers as a sustainable substitute for PVC pipes.

NIT Jalandhar Students: Created laminates from sugarcane bagasse fiber, suitable for acoustic panels, false ceilings, and interior materials.

These projects blended creativity with sustainability, reflecting ATIRA's vision for eco-efficient composites.

Incubation Centre

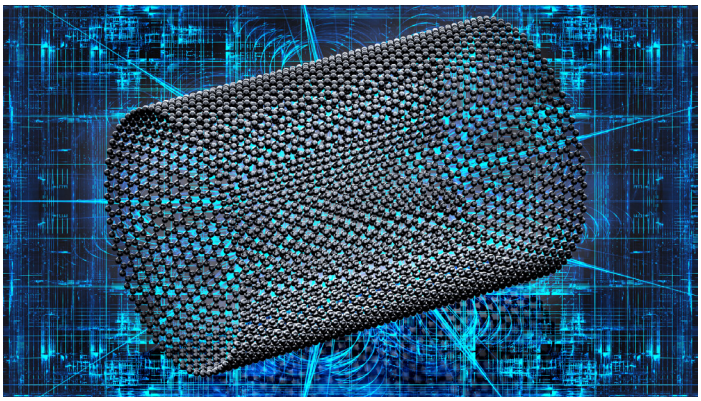
Four startups are currently incubating at ATIRA under the **National Technical Textiles Mission (NTTM),** with a focus on **sustainable materials, protective textiles, filtration media, and composite innovations.** The incubation program is designed to accelerate technology development, support early-stage entrepreneurs, and strengthen India's innovation pipeline in high-growth technical textile domains.

Tetrel Innovations LLP

Developing scalable manufacturing of graphene-based smart textiles that offer unmatched conductivity, flexibility, and thermal regulation — ideal for wearable sensors, energy-harvesting garments, and defense-grade adaptive uniforms. The technology has the potential to transform sectors from healthcare monitoring to battlefield intelligence.

Braidtech Composites

Working on next-generation composite structures through advanced braiding technologies for defense and automotive applications. Compared to conventional laminates, braided composites offer superior damage tolerance, torsional strength, and design flexibility.



Momentux Systems Private Limited

Integrating radome technology with Identification Friend or Foe (IFF) antennas into a unified aerodynamic structure that reduces drag, enhances signal integrity, and withstands extreme flight conditions. The result is reduced maintenance cycles, improved stealth, and higher mission reliability for defense and civil aviation.

Guerintech Systems

Developing novel composite materials engineered for deployable space communication antennas. These structures fold compactly during launch and unfurl seamlessly in microgravity. By leveraging shape-memory composites and thermally stable resin systems, Guerintech ensures antennas withstand extreme temperature cycles, vacuum exposure, and micrometeoroid impacts while maintaining high-gain signal performance for deep space communication and satellite networks.

SKILL DEVELOPMENT PROGRAM FOR PULTRUSION OPERATORS

ATIRA'S CENTER OF EXCELLENCE (COE) COMPOSITES ANNOUNCES SKILL DEVELOPMENT PROGRAM FOR PULTRUSION OPERATORS

The composites industry is undergoing unprecedented expansion as sectors such as infrastructure, automotive, renewable energy, aerospace, defence, and mobility increasingly adopt lightweight, high-strength materials to enhance performance and efficiency. With this surge in demand, the industry faces an urgent need for a skilled workforce capable of operating advanced manufacturing systems and delivering consistent, high-quality composite products.

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Pultrusion, one of the most promising continuous manufacturing processes for composite profiles, is rapidly gaining importance for its ability to produce high-strength, corrosion-resistant, and dimensionally stable components at scale. However, the availability of trained operators who understand materials, process control, testing requirements, and safety protocols remains limited.

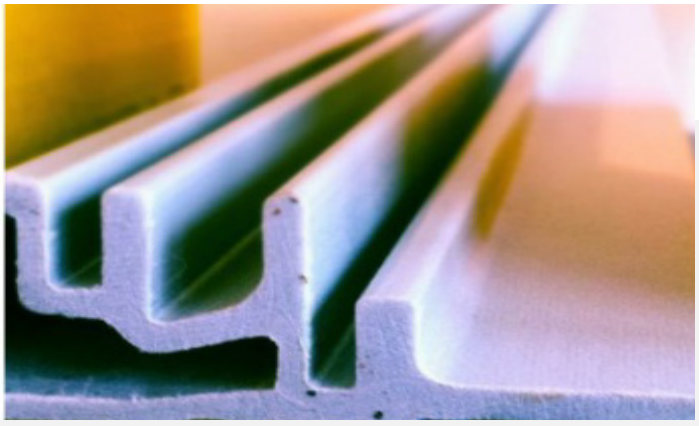
To bridge this skills gap, ATIRA is conducting a **Specialized Pultrusion Operator Training Program** under the **National Technical Textiles Mission (NTTM)** and aligned with **NSQF competency standards.** The program blends classroom learning with practical, lab-based instruction, enabling participants to:

- Understand raw materials, resin systems, and fiber architecture
- Operate pultrusion machinery and troubleshoot process variations
- Learn quality assurance and testing protocols for composite products
- Meet industry expectations for productivity, reliability, and safety

The response to this initiative has been encouraging. One batch is already in progress, and **registrations are now open for the next cohort,** creating an opportunity for professionals, technicians, and industry entrants to upskill in one of the fastest-growing domains of advanced manufacturing.

For registration and more details, please contact:

composites-research@atira.in



PARTNER WITH ATIRA

WHERE RESEARCH BECOMES INDUSTRY IMPACT

India's next leap in advanced materials, technical textiles, and composites will come from strong collaboration between industry, academia, startups, and national missions.

ATIRA stands at the intersection of science, innovation, and real-world application — offering deep technical expertise, advanced testing infrastructure, and decades of domain leadership.

Whether you are:

Developing next-generation materials

Scaling technical textile production

Building aerospace, defence, mobility, or infrastructure solutions

Seeking testing, certification, or conformity assessment

Launching a tech-textile startup

Or exploring R&D partnerships under NTTM or Tex-RAMPS

ATIRA is your research, validation, and innovation partner

ATIRA remains committed to advancing India's leadership in textiles through research, innovation, testing, and human capital development. Let's co-create the future of materials and technical textiles, **from idea to impact, from prototype to scale, from India to the world.**

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