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सीएसआईआर
CSIR
भारत का नवाचार इंजन
The Innovation Engine of India

CSIR TechConnect

Volume 1, Issue 3

01 July 2026

Cool Mix Strong Roads

Image: ETInfra.com

AI Tracks Smog | Silent Bridge Crossings | Sustainable Leather Solutions

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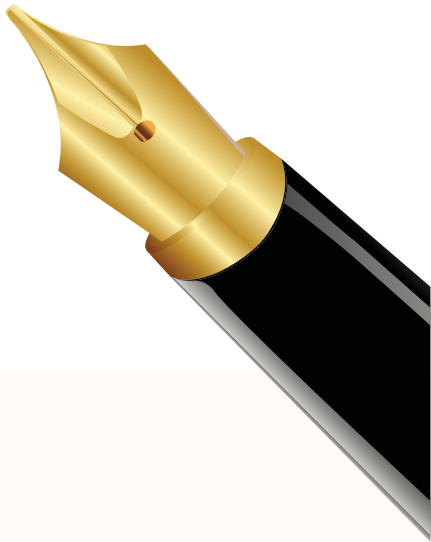
Editorial

The third issue of CSIR TechConnect showcases a diverse portfolio of technologies and innovations that highlight CSIR's commitment to addressing national priorities through science and technology. The stories featured in this edition span a wide range of sectors, including environmental sustainability, clean energy, advanced materials, artificial intelligence, infrastructure, manufacturing, and rural development. Readers will discover innovations such as AI-enabled tools for pollution mapping, sustainable leather processing technologies, advanced hydrogen storage solutions for the clean energy transition, smart bridge infrastructure systems, nature-based solutions for urban water management, cleaner cooking technologies, novel materials for additive manufacturing, and technologies aimed at strengthening rural communities. Together, these innovations demonstrate how CSIR research is translating scientific knowledge into practical, scalable solutions with tangible societal and economic benefits.

What makes this issue particularly encouraging is the enthusiastic participation from CSIR laboratories across the country. Scientists, technologists, and research teams have actively collaborated with the Science Communication and Dissemination Directorate (SCDD), sharing technical inputs, background materials, photographs, and expert insights that have helped shape the stories featured in these pages. This collective effort reflects a growing commitment within CSIR to communicate science beyond the laboratory and showcase the societal relevance of our innovations.

We are grateful to all participating laboratories for their valuable contributions and support. The encouraging response to CSIR TechConnect has reaffirmed the importance of communicating science in ways that are informative, accessible, and impactful. We hope to see even greater participation from CSIR laboratories in future issues, enabling us to showcase a broader spectrum of innovations emerging from across the CSIR ecosystem.

— Editors



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AI-assisted tools were used to enhance clarity and readability in selected articles.

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Marching in Amrit Kaal with high end Research & Development

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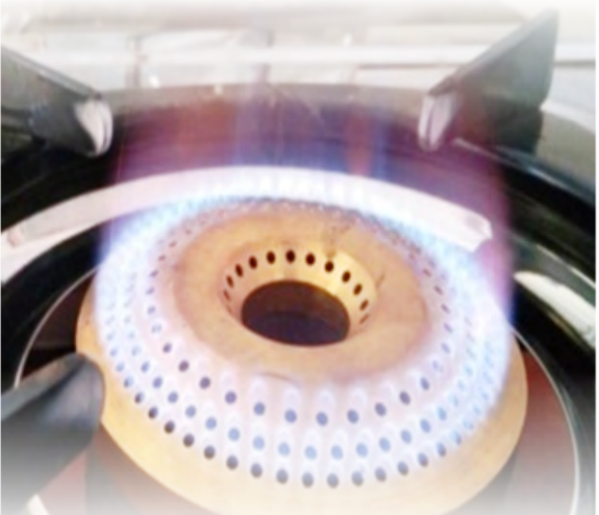

Cool Mix, Strong Roads: The Modified Mix Seal Surfacing "MSS+" Success Story

What if roads could be built without the heat? CSIR-CRRI's Modified Mix Seal Surfacing (MSS+) technology enables road construction at ambient temperatures, cutting energy use, lowering emissions, and delivering durable rural roads at lower cost.

A road is often the first sign of opportunity. It can shorten the journey to a hospital, help farmers reach markets, connect children to schools, and bring remote communities closer to jobs and essential services. Across rural India, roads do far more than carry vehicles—they carry economic growth and social development.

Yet building and maintaining these roads is not always easy. Many rural regions face challenges ranging from difficult terrain to limited infrastructure. Traditional road-construction methods can be expensive, energy-intensive, and difficult to implement, particularly in remote locations. One of the biggest challenges lies in an ingredient that most people never think about: HEAT.

The Hidden Cost of Hot Roads

Conventional road surfacing techniques rely on heating bitumen and stone aggregates to high temperatures before they can be laid on the road surface. The process works well, but it comes with a cost. Large amounts of fuel are required to generate and maintain those temperatures. The heating process releases greenhouse gases and fumes, while transporting hot materials over long distances adds further logistical difficulties and expense. In rural areas, where roads are often located far from production facilities, these challenges become even greater. Scientists at CSIR-Central Road Research Institute (CSIR-CRRI) wondered whether roads could be built differently. Their answer was a technology called Modified Mixed Seal Surfacing (MSS+).

A Road Built Without Heating

What makes MSS+ remarkable is its simplicity. Unlike conventional methods, MSS+ does not require bitumen and aggregates to be heated before construction. Instead, it uses a specially designed polymer-modified bituminous emulsion mixed with graded aggregates that can be applied at ambient temperatures. The result is a road-building process that eliminates much of the smoke, fuel consumption, and operational complexity associated with hot-mix surfacing. Because heating is no longer required, energy consumption can be reduced by nearly 70–80 percent. Lower fuel use also means fewer greenhouse gas emissions and cleaner working conditions for construction crews.

Designed for India's Conditions

One of the most practical advantages of MSS+ is its ability to function under conditions that often disrupt conventional road construction. Monsoon rains and humid weather can make hot-mix operations difficult. Producing, transporting, and laying heated materials during such conditions is often challenging. MSS+, however, can be applied without these constraints, allowing projects to continue even when weather conditions are less than ideal. For rural communities waiting for road connectivity, that flexibility can make a significant difference.

Greener Does Not Mean Weaker

Environmental benefits alone are not enough for a road technology to succeed. The road must also perform. Field and engineering studies have shown that MSS+ provides improved skid resistance, enhanced surface texture, and greater durability compared with traditional seal surfacing methods. It also offers resistance to common causes of road deterioration such as rutting, stripping, and weather-related damage.

Photo showing Modified Mix Seal Surfacing (MSS+) Truck Plant Mixer

The technology can be adopted using existing paving equipment, meaning contractors do not need to invest in expensive new machinery. Construction can be completed 30–40 percent faster, while overall project costs can be reduced by as much as 40 percent. In other words, the roads are not only greener—they are also economical.

From Research to Rural Roads

Many innovations remain confined to laboratories. MSS+ has already reached the field. More than 200 kilometres of rural roads have been taken up using the technology under the Pradhan Mantri Gram Sadak Yojana (PMGSY) in Uttar Pradesh. The first demonstration road, built near Lucknow in 2022, continues to carry hundreds of commercial vehicles every day without signs of surface distress.

Following its successful performance, the technology has expanded to districts including Prayagraj, Ghaziabad, Varanasi, Gorakhpur, and others. Field evaluations have reported strong durability, improved moisture resistance, and good performance under varying climatic conditions. To facilitate efficient implementation of the technology, CSIR-CRRI has also developed an In-situ Automatic Modified Mix Seal Surfacing (MSS+) Mixing Plant. This plant is mounted on a truck chassis, automatically prepares and mixes the various ingredients of MSS+ mix such as customized bituminous emulsion with graded aggregates and mineral fillers directly at the construction site at ambient atmospheric temperature. This eliminates the need for transporting pre-mixed materials over long distances and ensures uniform mixing and quality control during construction. The automated system improves construction efficiency, reduces material wastage, and enables faster execution of rural road projects, particularly in remote areas where conventional hot-mix plants may not be readily accessible.

A Smoother Path to Sustainable Development

As India seeks greener infrastructure and lower-carbon development pathways, innovations such as MSS+ show how small changes in engineering can produce large societal benefits. Roads will always be essential to development. The question is how they are built. By reducing fuel consumption, lowering emissions, improving worker safety, and cutting costs, MSS+ offers a glimpse of a future where infrastructure serves both people and the planet. The next time you travel on a rural road, it may not just be taking you somewhere. It may also represent a quieter, cleaner way of building the connections that keep a country moving.

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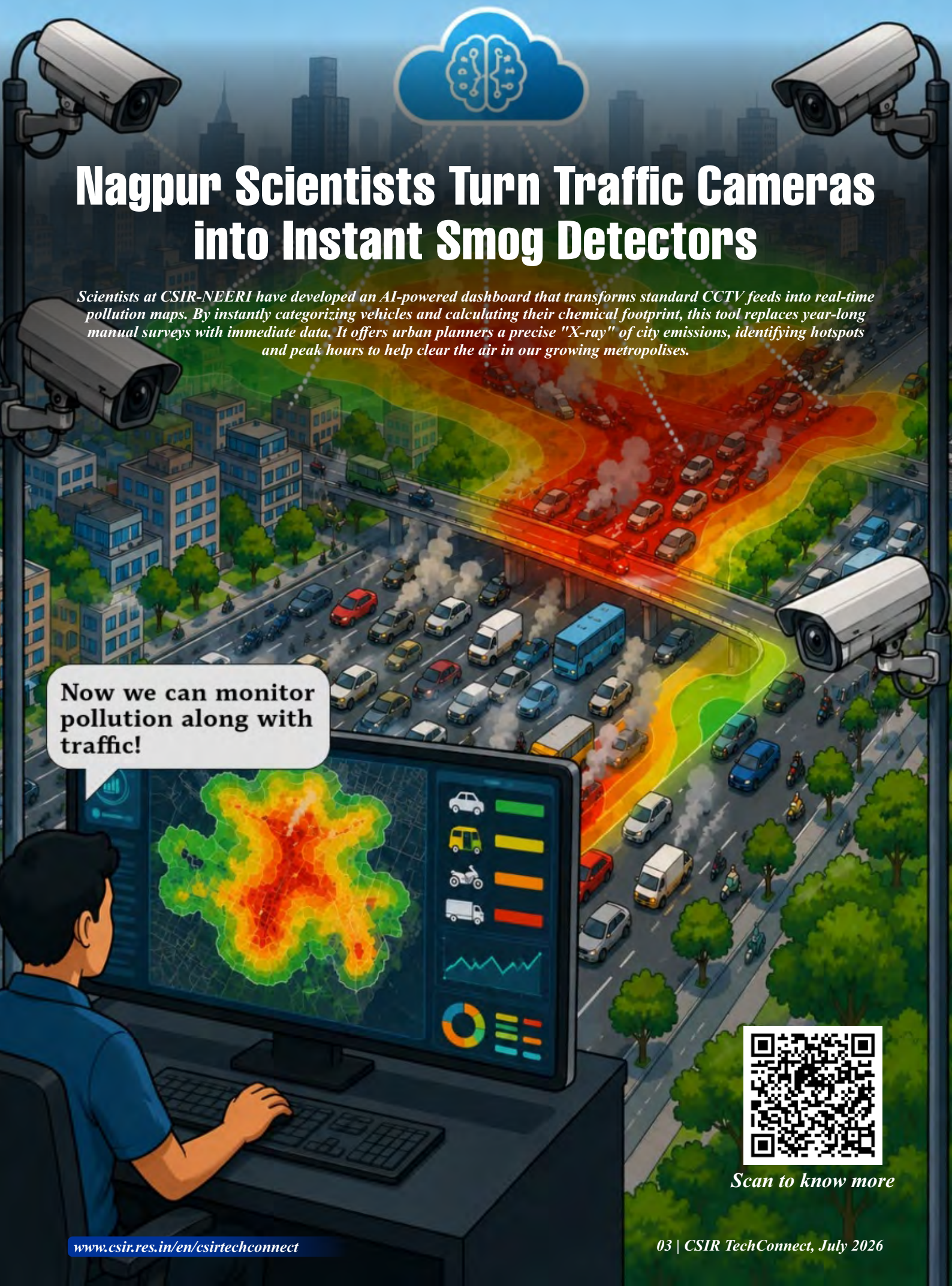
Nagpur Scientists Turn Traffic Cameras into Instant Smog Detectors

Scientists at CSIR-NEERI have developed an AI-powered dashboard that transforms standard CCTV feeds into real-time pollution maps. By instantly categorizing vehicles and calculating their chemical footprint, this tool replaces year-long manual surveys with immediate data. It offers urban planners a precise "X-ray" of city emissions, identifying hotspots and peak hours to help clear the air in our growing metropolises.



Scan to know more

Imagine standing at a busy city intersection, like Nagpur's Ajni Square, during the morning rush. You see a chaotic symphony of buzzing two-wheelers, rumbling buses, and idling cars. You know they are emitting invisible gases, but exactly how much? And which vehicle is the biggest culprit? Until recently, answering that required an army of researchers with clipboards, followed by months of data crunching. By the time the report was published, the traffic patterns had already changed. Now, scientists at the CSIR-National Environmental Engineering Research Institute (CSIR-NEERI) have found a way to make the invisible visible, instantly.

Sample of how the AI dashboard identifies and counts different vehicle categories

Led by a team including Dr. Rahul Vyawahare and Dr. K.V. George, the researchers have developed the AI-Integrated Line Source Emission Inventory (AI-LSEI) dashboard. Think of it as a "digital brain" that plugs into the existing CCTV cameras already watching our streets. Instead of just looking for traffic violations, this AI identifies every vehicle that passes by, classifies it (is it a car, a scooter, or a heavy truck?), and calculates the pollution it's puffing out into the air we breathe.

The Problem with the "Old Way"

Traditionally, creating a "pollution inventory", a fancy term for a detailed map of where emissions come from—was a slow, manual process. Traditional studies depend on manual counts and surveys, which can take up to one year to generate results. In a rapidly growing city like Nagpur, which added 1.5 lakh vehicles to its roads in the last year alone, a year-old report is essentially a history lesson, not a management tool.

The AI-LSEI dashboard changes the game by working in real-time. It uses the live video feed to count traffic and then applies "emission factors", scientifically established values that estimate how much chemical waste a specific type of engine produces per kilometer.

From Pixels to Pollutants

The AI doesn't just see a "vehicle"; it recognizes categories ranging from two-wheelers to heavy commercial trucks and tractors. It even get city specific data from the national Parivahan portal to understand the engine technology (like BS-IV or BS-VI standards) and fuel types common in the area.

Within seconds, the dashboard calculates the "big four" of urban air pollution:

- **Particulate Matter (PM):** Tiny soot particles that can enter our lungs.
- **Nitrogen Oxides (NOx):** Gases that contribute to smog and respiratory issues.
- **Carbon Monoxide (CO):** A colorless, odorless gas that reduces oxygen delivery in the body.
- **Hydrocarbons:** Compounds that contribute to ground-level ozone. The results are then splashed onto a GIS-based map (a digital map like Google Earth), highlighting "hotspots" in glowing colors. If a specific corridor is choking under heavy truck traffic at 3:00 PM, the map turns red, giving authorities an immediate red alert.

Testing the Tech: The Stadium Effect

The team didn't just build this in a lab; they tested it on the real world. During a cricket match at the Vidarbha Cricket Association Stadium on January 21, the dashboard recorded a massive spike. As fans poured in, Carbon Monoxide levels surged, accounting for over 57% of the total emissions during the peak hours.

Closer to home, a pilot project at CSIR-NEERI's own gate on Wardha Road proved the system's precision. From midnight to 4:00 PM on a typical Tuesday, the system recorded exactly 53 kg of Carbon Monoxide and 3.3 kg of Particulate Matter passing through that single point.

A Cleaner Future

This tool isn't just for scientists; it's for the people who run our cities. Smart City offices, traffic police, and urban planners can use this data to decide where to divert traffic, where to synchronize signals to reduce idling, or where to prioritize electric bus routes.

While the AI is still learning—it currently needs a little human help to distinguish between electric vehicles and petrol ones—the potential is massive. By turning every street camera into a scientific sensor, we are finally moving from guessing about our air quality to managing it in the moment.

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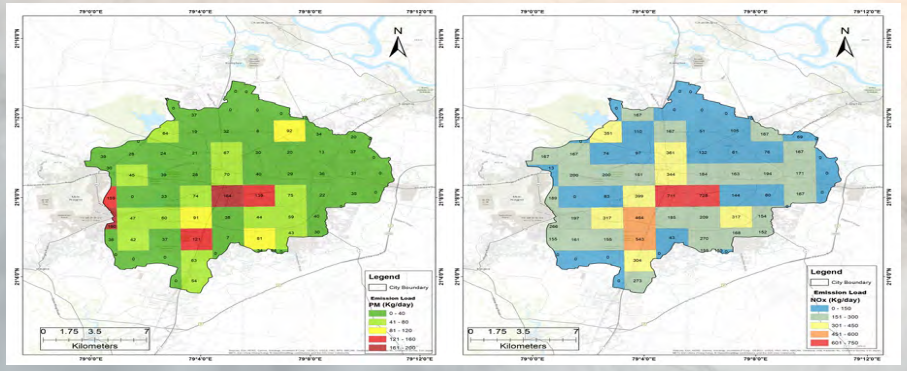

The End of the Bridge "Thump-Thump": How Flexible Concrete is Smoothing Our Streets

Traditional bridge joints are noisy, bumpy, and prone to decay. Scientists at CSIR-SERC have developed a revolutionary "jointless" technology using Engineered Cement Composite (ECC) to eliminate these gaps. This innovation promises smoother rides, lower maintenance costs, and a significant boost to the lifespan of India's infrastructure.

If you have ever driven over a flyovers and bridges, you know the rhythm. Thump-thump. Thump-thump. It is the physical heartbeat of our infrastructure—the sound of tires hitting expansion joints. These metal or rubber gaps are designed to let bridges "breathe," expanding in the summer heat and contracting in the winter chill. But for drivers, they are a source of jerks and noise; for engineers, they are a perennial headache. These joints collect debris, leak water into the skeleton of the bridge, and eventually rattle loose, demanding expensive repairs.

Scientists at the CSIR-Structural Engineering Research Centre (CSIR-SERC) in Chennai have developed a breakthrough "jointless" bridge technology that aims to silence the thump-thump for good. By replacing clunky mechanical joints with a high-performance material called Engineered Cement Composite (ECC), they are creating seamless, "stretchable" bridge decks.

The Magic of "Bendable" Concrete

To understand why this is a game-changer, we have to look at the material itself. Standard concrete is strong but brittle—think of it like a ceramic plate; if you try to bend it, it breaks. Expansion joints were the only way to prevent bridges from cracking under thermal stress.

ECC, however, is often nicknamed "bendable concrete." It is a specialized cement-based system designed with high tensile performance. Unlike traditional concrete that fractures under pressure, ECC can deform and stretch. By using this material to link bridge sections, scientists have created a "Jt-Free" (Joint-Free) system. It acts like a flexible ligament between the "bones" of the bridge, absorbing movement without the need for an open gap.

Why It Matters for Your Commute

The benefits of a seamless bridge extend far beyond a quieter cabin.

- Riding Comfort: Without the literal hurdles of joints, the "jerks" felt by passengers vanish. It turns a bumpy overpass into a smooth ribbon of road.
- Fuel Efficiency: Every time a vehicle hits a joint, it loses a tiny bit of momentum. Over millions of cars, a smoother surface actually contributes to better fuel economy and less wear and tear on tires and suspensions.
- Durability: In the world of civil engineering, water is the enemy. Traditional joints often leak, allowing rainwater and salt to seep into the structural beams below, causing hidden rust. The Jt-Free system is a continuous shield, preventing seepage and structural damage.

From Lab to Life

The technology has successfully navigated the rigors of laboratory testing. The beauty of this innovation lies in its versatility: it isn't just for the mega-projects of the future. The Jt-Free system can be retrofitted onto existing bridges, replacing old metallic or polymeric joints that have reached the end of their lives.

While the initial material is advanced, its "low cost to performance ratio" makes it a winner for a developing economy. Because it requires less reinforcement and significantly less maintenance over its life cycle, it is a rare "win-win" for both the environment and the taxpayer.

As India continues its massive infrastructure push, the work coming out of Chennai suggests that the future of travel isn't just about going faster—it's about a journey that is seamless, silent, and built to last.

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The Hydrogen Sponge: How Machine Learning Could Solve Energy's Tightest Squeeze

For centuries, human progress has been defined by how we harness energy, yet our lightest fuel—hydrogen—remains the hardest to hold. By moving away from bulky high-pressure tanks and toward "solid-state" storage, scientists are using machine learning to scout the chemical landscape. This digital shortcut is helping us discover the perfect materials to soak up hydrogen like a sponge, clearing the path for a decarbonized world.

Representative image

When our ancestors first tamed fire, they didn't just gain a way to stay warm; they unlocked a biological shortcut. Cooking made energy easier to extract from food, fueling the growth of larger, more complex brains. In a very real sense, the history of being human is the history of mastering energy. From the steam engines of the Industrial Revolution to the electrical grids of today, every great leap in our society has been tied to a new way of powering it.

Today, we stand at another turning point. We need energy that is clean, abundant, and portable. Hydrogen is the frontrunner for this role, a fuel that can power a truck or a factory and leave nothing behind but water vapor. But hydrogen has a "density" problem. It is the lightest element in the universe, a flighty gas that occupies massive amounts of space. To pack enough of it into a car or a ship, we currently have to squeeze it to bone-crushing pressures or freeze it to temperatures colder than the surface of dwarf planet Pluto (-253°C).

These methods work, but they are expensive, energy-intensive, and require heavy, complex tanks. But what if we didn't have to squeeze hydrogen at all? What if we could simply let it soak into a solid material, like water into a sponge?

The Atomic Sponge

This is the promise of solid-state hydrogen storage. Instead of forcing gas into a hollow tank, we use "metal hydrides", specially designed alloys that act like a microscopic parking lot for hydrogen atoms. Inside these materials, hydrogen atoms find cozy spots to nestle within the metal's crystal structure.

The beauty of this approach is its elegance: you can pack more hydrogen into a solid block of metal than you can into a high-pressure gas tank of the same size. When you need the energy, you simply tweak the temperature or pressure, and the "sponge" releases the gas. However, finding the right material is like looking for a needle in a haystack the size of a galaxy. Some metals grab hydrogen too tightly and won't let go; others are too "leaky."

A Digital Scout in the Chemical Wilderness

For fifty years, scientists have painstakingly tested thousands of materials in labs. But there are millions of possible combinations of elements. If we continued at a traditional pace, the energy transition might come too late.

This is where Machine Learning (ML) changes the game. Scientists from CSIR-National Chemical Laboratory (CSIR-NCL), Pune are using ML not just as a calculator, but as a scout. By feeding computers data from decades of past experiments, the scientists teach them to recognize the "fingerprints" of a good storage material. These models can scan thousands of alloys virtually in seconds, predicting their storage capacity, stability, and how easily they will release their cargo.

Instead of a scientist spending months in a lab testing a material that might fail, the CSIR-NCL models can point and say, "Look here; this combination of metals has the best chance." It can be called the inverse design. Rather than testing materials to see what they do, we start with the goal—"I need a material that works at room temperature"—and let the computer help us work backward to find the recipe.

Seeing the Map

The field is moving away from the era of "trial and error." By combining the deep intuition of materials science with the processing power of artificial intelligence, a map of the chemical wilderness is finally being built.

The "perfect" material hasn't been found yet, but the fog is lifting. The patterns of how atoms interact are becoming clearer, making the search for clean energy faster and more precise. The story of energy is entering its next chapter, and this time, the pen is being guided by the invisible hand of machine learning.

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Beyond the Big Pipes: CSIR-NEERI's Ingenious Solution for Smarter Cities

As India generates 72,000 million liters of sewage daily, traditional, energy-hungry treatment plants are struggling to keep pace. Scientists at CSIR-NEERI have developed an ingenious "Up-flow Compact Constructed Wetland" (UCCW) that uses plants and gravity to clean water. This compact, nature-based innovation transforms wastewater into a reusable resource, offering a sustainable blueprint for the future of urban sanitation.

Every day, urban India generates a staggering 72,000 million liters of sewage. To visualize that, imagine a line of water tankers stretching from Delhi to London and back, several times over. Most of this waste disappears into our rivers and lakes untreated. This leads to an environmental crisis called eutrophication, a process where excess nutrients like nitrogen and phosphorus trigger massive algae blooms that suck the oxygen out of the water, effectively "suffocating" the fish and plants beneath.

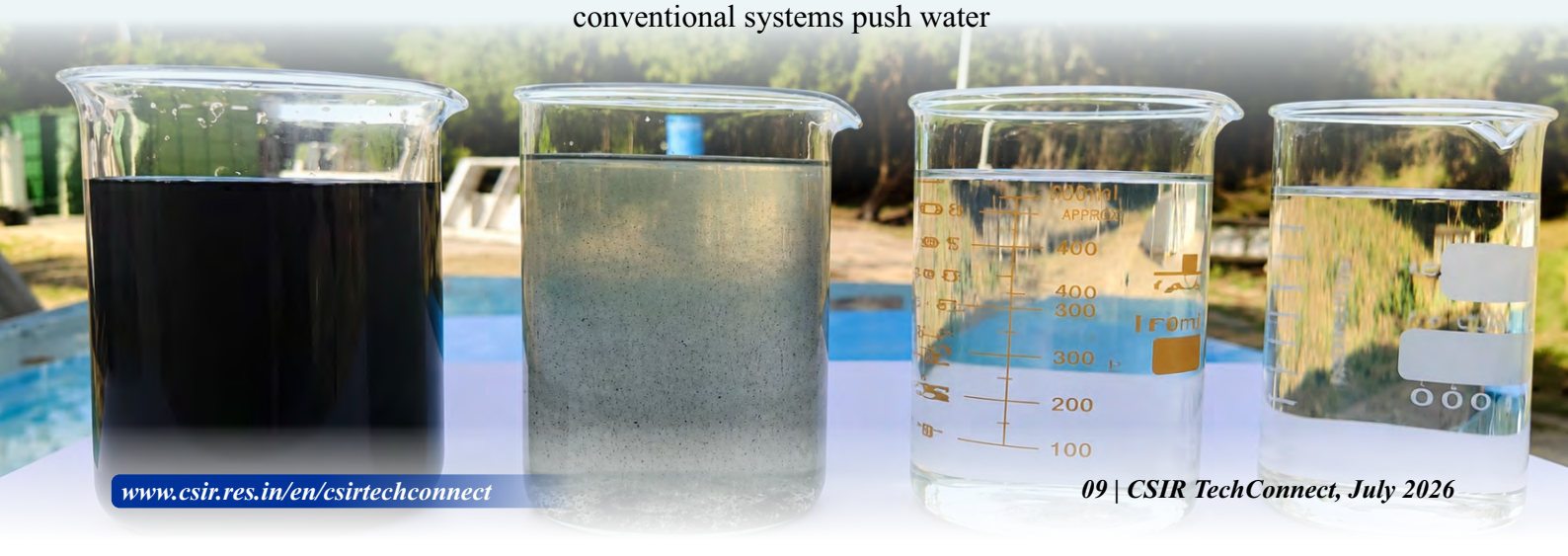
Traditional Sewage Treatment Plants (STPs) are our usual line of defense, but they have a "hunger" problem. They eat up massive amounts of electricity, require sprawling plots of land, and rely on complex mechanical parts that are expensive to maintain. For many residential campuses or crowded city blocks, these giant plants simply aren't a practical fit. But what if we could shrink a treatment plant and make it run on the quiet, effortless principles of a natural marsh?

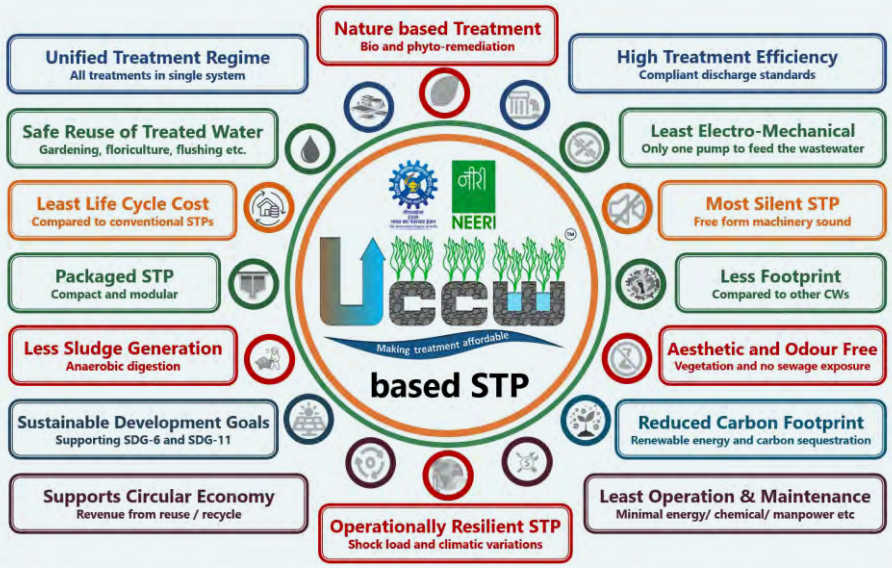
15 KLD packaged modular UCCW-based STP, installed at CSIR-NEERI, Nagpur (Left); 25 KLD institutional plant at CSIR-CSIO, Chandigarh (right)

The Secret is in the Lift

Scientists at the CSIR-National Environmental Engineering Research Institute (CSIR-NEERI) have looked to nature to find a more elegant solution. Their answer is the patented Up-flow Compact Constructed Wetland (UCCW), a system that works like a natural kidney for our cities. It has reached Technology Readiness Level (TRL) - 8, meaning it is a fully matured technology ready for the real world. Most conventional systems push water through a series of separate, energy-hungry tanks for screening, settling, and aeration. The UCCW flips this script. It is an integrated system where the water moves upward through sequential wetland zones. Think of it as a vertical filter where gravity and biology do the heavy lifting.

As the sewage rises through the patented Up-flow Floating Surface and Sub-Surface zones, several natural cleansers go to work. Physical filtration occurs as engineered filter media traps suspended solids, effectively straining the water. Simultaneously, microbial





biodegradation takes place as tiny, beneficial bacteria living on the media "eat" the organic pollutants. Finally, the system benefits from plant-assisted uptake, where wetland plants act like living straws, absorbing the nutrients that would otherwise cause those toxic algae blooms in our rivers.

Nature Meets Engineering

A defining feature of the UCCW is its "green architecture." Unlike traditional plants that use massive, noisy fans to blow air into the water, a process called aeration, the UCCW relies on passive oxygen transfer. It breathes naturally. Because the process is governed by gravity and natural kinetics, it uses very little power. Electrical energy is limited to small auxiliary operations like pumping. This makes it a "decentralised" hero; you don't need a massive, city-wide network of pipes. You can install a modular UCCW unit right where the sewage is produced, in a school, a housing society, or a commercial complex.

From Waste to Wealth

The result of this process is high-quality water that meets strict national standards. The system effectively reduces organics and nutrients as well as clears out pathogens like faecal coliform. As India moves toward a circular water economy, the UCCW provides water ready for landscaping and gardening, keeping city parks green without tapping into drinking water. It can be used for flushing and cooling, reducing the freshwater footprint of large buildings, or for waterbody rejuvenation, safely refilling local ponds and lakes. Even the leftover solids don't go to waste; they can be harvested as manure for floriculture and fodder.

A Proven Path Forward

The UCCW is a patented, Indian-made innovation backed by strong Intellectual Property Rights. The journey of this technology began with small pilot units in Nagpur and a 3 Kilo Liters/Day (KLD) plant in Deolapar. It quickly proved its worth, scaling up to a 25 KLD institutional plant at CSIR-CSIO, Chandigarh. Today, the innovation has reached new heights: from compact 15 KLD modular units at CSIR-NEERI to massive 400 KLD installations currently being implemented for Western Coalfield Limited (WCL) and engineering colleges in Pollachi. This progression proves that the system is not just a laboratory success, but a robust solution ready for India's diverse landscapes.

It aligns with national goals like the Swachh Bharat Mission and Viksit Bharat 2047, proving that we don't need high-energy, high-cost models to solve local problems. By mimicking the Earth's natural wetlands within a compact frame, CSIR-NEERI has provided a blueprint for the future—a future where wastewater is no longer an environmental burden, but a vital, reusable resource for sustainable cities.

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Flowers of Opportunity: Bringing Peony Farming to India's Hills

From a luxury import to a local income revolution—discover how one delicate flower is quietly turning Himalayan farmers into high-value growers.

High in the cool, misty valleys of the Himalayas, where farming has always been shaped by tough terrain and limited crop choices, a quiet transformation is taking place. Fields that once grew only traditional crops are now beginning to bloom with something new, vibrant, and valuable—peony (पियोनी / *paeonia lactiflora*), a flower known across the world for its beauty and premium market demand.

For the first time in India, scientists at CSIR–Institute of Himalayan Bioresource Technology (CSIR-IHBT), Palampur, have successfully introduced and standardised the cultivation of peony. But this is not just the story of a new flower entering Indian fields. It is the story of how science, when applied thoughtfully, can open doors to new livelihoods and reshape rural economies.

A Flower with Potential, A Region with Need

The Himalayan region is rich in natural beauty but often limited in economic opportunities. Farmers here face challenges such as small landholdings, harsh climates, and restricted market access. Traditional crops like wheat, maize, and pulses often provide modest returns, making it difficult for families to significantly improve their incomes.

This is where peony comes in. Globally, peony is considered a luxury flower, widely used in bouquets, decorations, and special events. Its demand is high, and so is its price. However, until recently, India relied heavily on imports to meet this demand.

CSIR-IHBT saw an opportunity. What if this high-value flower could be grown locally, right here in the Himalayan regions?

From Research Lab to Farmers' Fields

Introducing peony into Indian agriculture was not as simple as planting seeds. Peony is a sensitive plant. It requires specific conditions, especially cold temperatures for a process called vernalization, which is essential for flowering. Without the right climate and cultivation methods, the plant simply does not perform well.

Scientists at CSIR-IHBT began by carefully studying the plant's requirements. They identified suitable regions in the Himalayan belt where the natural climate could support peony cultivation. But that was only the beginning.

They developed a complete package of practices, covering every stage of cultivation:

- Propagation techniques using root crowns to ensure healthy plant growth
- Optimal planting density to maximize the number of flowers per unit area
- Nutrient management plans tailored to local soil conditions
- Integrated pest management strategies to protect the delicate blooms

Building Farmer Confidence

A new crop always brings uncertainty. Farmers naturally ask questions: Will it grow? Will it sell? Is it worth the effort?

Understanding this, CSIR-IHBT scientists went beyond the lab. They directly engaged with farmers—training them, answering their doubts, and demonstrating techniques in real field conditions.

These interactions were crucial. Instead of simply telling farmers what to do, CSIR-IHBT scientists worked alongside them, building confidence step by step. Farmers learned not only how to grow peony but also how to manage it as a profitable crop.

Turning Flowers into Income

The economic argument for the peony is compelling. In the floral market, a single cut peony can fetch between ₹120 and ₹150. Even the "seeds" of the business—the root crowns used for planting—can be sold for ₹400 to ₹500 each.

For a Himalayan farmer with a small plot of land, this is a game-changer. Economic assessments show that even a modest area of 500 square meters can generate substantial profit. In a region where land is scarce and traditional crops like wheat or maize offer thin margins, the peony provides "more crop per drop" and more value per inch of soil.

Beyond Income: A New Agricultural Identity

Peony cultivation does more than increase income. It introduces diversification into farming systems. Instead of depending on a few traditional crops, farmers can now explore high-value horticulture.

This diversification reduces risk. If one crop fails or prices drop, others can provide support. It also encourages farmers to think

more like entrepreneurs—planning production, targeting markets, and improving quality.

A Path to Self-reliance

India imports a large quantity of ornamental flowers every year. By growing peony locally, farmers and researchers together are helping reduce this dependence.

This aligns directly with the vision of Atmanirbhar Bharat—building self-reliance through indigenous capabilities. Instead of importing expensive flowers, India can now produce them within its own borders, keeping value within the country.

Moreover, locally grown peonies can also find markets abroad, creating export opportunities and further boosting rural incomes.

A Blooming Future

As more farmers adopt peony cultivation, the impact is expected to grow. Entire regions could develop a reputation for high-quality flower production. Local economies could become more vibrant. Young people, who often migrate to cities in search of work, might find new opportunities in agriculture itself.

The hills of the Himalayas, once known mainly for their scenic beauty, could soon become known for their blooming peony fields.

From a delicate bloom to a powerful source of income, peony cultivation is helping rewrite the story of Himalayan agriculture.

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The Chemistry of Comfort: How India Reimagined the 150-Year-Old Secret of Leather

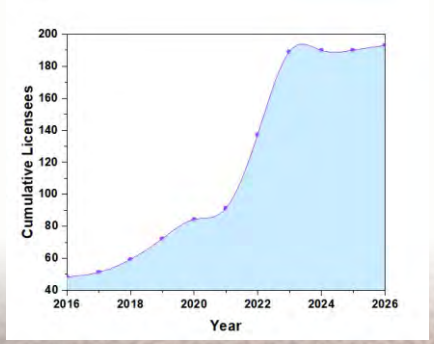
A breakthrough "waterless" technology is cleaning up one of the world's most polluting industries. By eliminating toxic steps in the tanning process, CSIR-CLRI scientists are saving millions of liters of water and keeping heavy metals out of our rivers. It is a masterclass in how simple chemical tweaks can lead to a global environmental revolution.

Every time you pull on a pair of sleek leather boots or settle into a soft leather armchair, you are enjoying the results of a chemical miracle called chrome tanning. Since the 1880s, this process has been the gold standard for the industry, prized for making leather supple, durable, and resistant to heat.

But this miracle has always had a "thirsty" and messy secret. To turn a raw hide, the skin of an animal before it has been processed, into a finished product, tanneries historically use vast oceans of water. On average, processing just one ton of hide requires between 30,000 and 50,000 liters. For decades, the global scientific community thought this massive water consumption and the resulting toxic waste were the unavoidable "price of progress."

However, in the labs of the CSIR-Central Leather Research Institute (CSIR-CLRI) in Chennai, researchers have achieved what was once thought impossible. They have developed a way to tan leather by eliminating the two most damaging steps of the process, effectively reinventing an industry that had not changed in 150 years.

The Problem: A Chemical Tug-of-War
To understand the breakthrough, we first have to look at the chemistry of the tannery floor. It is a bit like a chemical tug-of-war.



WCTT Cumulative Industrial Licensee Adoption, 2016-26

After an animal hide is cleaned, it is naturally alkaline. But for chromium, the mineral agent that prevents the leather from rotting, to penetrate deep into the microscopic fibers, the hide needs to be acidic. To get there, tanneries perform a step called pickling, using massive amounts of water, sulfuric acid, and common salt. Once the chromium has soaked in, they must then reverse the acidity using more chemicals (a step called basification) to lock the chromium in place.

This back-and-forth dance creates a toxic cocktail. The leftover water is laden with salt and dissolved chromium compounds, contributing to high Total Dissolved Solids (TDS), a measure of all the organic and inorganic substances dissolved in a liquid. In India alone, this results in nearly 20,000 tons of chromium being discharged into water bodies annually, placing a massive burden on our environment.

The Innovation: Working with Nature
The scientists of CSIR-CLRI asked a revolutionary question: What if we didn't need the water or the salt at all?
They realized that at the end of the cleaning stage, the raw hide already contains enough internal moisture to facilitate chromium diffusion, provided the conditions are precisely controlled. By eliminating pickling and basification entirely, the new Waterless Chrome Tanning Technology (WCTT) allows the chromium to penetrate and bond directly with the collagen using only the hide's residual moisture.

The results of this process are staggering. By simply changing the chemical "recipe," this "Made in India" technology saves 400 million liters of water annually, which is equivalent to the annual drinking water needs of approximately 800,000 people. Furthermore, the process prevents 5,000 tons of chromium from entering river systems every year and removes 20,000 tons of salt from effluent streams, preventing the severe contamination of groundwater.

A Practical Bridge
Despite these wins, the leather industry is deeply traditional. Many tanners, especially in Micro, Small, and Medium Enterprises (MSMEs), were hesitant to go completely waterless, fearing the hides might swell or catch fungus.

Ever adaptive, CSIR-CLRI developed a Modified WCTT. This version uses a tiny, controlled amount of water and just 1–2% salt. It acts as a "confidence-building bridge," giving tanners the peace of mind they need while still delivering the core environmental benefits. Best of all, it requires zero new equipment or capital investment. A tannery owner doesn't need to buy a single new machine; they simply adjust their existing production workflow.

A Global Benchmark
This isn't just a local success. WCTT is a globally patented technology (Patent No. IN355116) that has already been adopted by over 190 licensees in India and demonstrated in countries like Egypt, Ethiopia, and Vietnam.

It aligns perfectly with national goals like the National Water Mission and Swachh Bharat. By recognizing WCTT as the "Best Available Technique" under environmental frameworks, India has the chance to lead the world in sustainable manufacturing. Science has provided the solution; now, it is up to the industry to embrace a future where the leather we love doesn't come at the cost of the water we drink.

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Can Nature Build the Future? Rethinking Plastics for a Sustainable World

From rice husk and bamboo to next-generation composites, CSIR-IICT is demonstrating how natural resources can power sustainable innovation. The result is a new class of materials that balances performance, affordability, and environmental responsibility.

Plastic has quietly shaped the modern world. It keeps food fresh, makes vehicles lighter, and allows products to be designed in ways that were once impossible. It is strong, flexible, and easy to use. That is exactly why it is everywhere.

But there is a catch. The same plastic that makes life convenient also refuses to go away. It lingers in landfills, drifts into oceans, and slowly breaks into microplastics tiny particles below 5 mm that enter our soil, water, and even our bodies. What began as a miracle material has turned into one of the biggest environmental challenges of our time.

The real problem is not plastic itself. It is how we make it and what we make it from. If modern life depends on plastic, then the answer lies in reinventing it rather than rejecting it.

Bringing Nature Back into Materials

At CSIR–Indian Institute of Chemical Technology (CSIR–IICT), scientists are working on a new idea—one that brings nature back into the story. Instead of relying only on synthetic materials, they are blending thermoplastic polymers with natural fibres such as rice husk, jute, coir, bamboo, and even agricultural residues. This approach has led to the development of Natural Fibre Reinforced Plastics, or NFRPs, a new generation of materials that combine strength with sustainability.

These natural fibres grow in fields, not factories. They are renewable, biodegradable, and widely available across India. In many cases, they are by-products of agriculture, often left unused or even burned as waste. By bringing them into material design as reinforcement phases within a polymer matrix, scientists are turning something ordinary into something extraordinary.

Engineering Strength the Smart Way

The challenge, however, is not as simple as mixing fibres with plastic. Natural fibres are hydrophilic rich in cellulose, hemicellulose and lignin while synthetic polymers are hydrophobic. Without a strong connection between them, the material would be weak and unreliable.

Researchers at CSIR–IICT have developed ways to treat and modify these fibres employ mechanochemical processing as the primary fibre modification strategy. In this approach, natural fibres are subjected to high-energy mechanical action including shear, compression and impact within a twin-screw extruder operating under controlled temperature and screw-speed profiles. so that they interact smoothly with the plastic matrix. Once this bond is achieved, the material becomes strong, durable, and capable of withstanding real-world conditions. It can resist moisture, handle stress, and perform in demanding environments, just like conventional plastics.

What emerges is not a compromise but an improvement a material that keeps the advantages of plastic while reducing its environmental impact.

From Farm Residue to Industrial Resource

The impact of this innovation becomes clearer when we look at its applications. In automobiles, lighter materials improve fuel efficiency by reducing overall vehicle weight. In construction, they offer strong and sustainable alternatives for panels and reinforcements. In packaging, they provide durability without adding to long-term waste.

What makes this approach powerful is how it connects agriculture with industry. Crop residues that were once discarded now gain value as reinforcement feedstock. Farmers can benefit from new income streams, while industries access sustainable raw materials. This creates a cycle where waste is reduced and resources are used more wisely.

Building a Future That Works with Nature

For a long time, materials were judged mainly by how strong or efficient they were. Today, another question matters just as much—how do these materials affect the environment over their entire life cycle?

Natural Fibre Reinforced Plastics offer an answer. They reduce dependence on fossil fuels, lower emissions, and promote the use of renewable resources, all while maintaining performance. The technology aligns with national priorities of Atmanirbhar Bharat, circular economy and sustainable materials development, and CSIR–IICT is working to scale it from laboratory compounding to pilot-plant demonstration and industry technology transfer.

As India moves forward on the path of growth and self-reliance, such innovations show that progress does not have to come at the cost of nature. The future of materials will not be defined by strength alone, but by balance.

The question is no longer whether nature can build the future. It is whether we are ready to let it.

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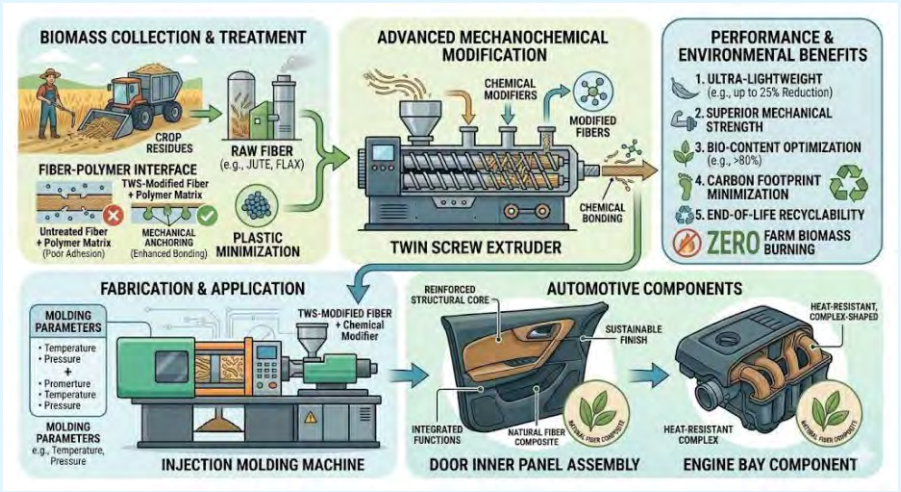


Scan to know more

If It Turns Pink, Don't Drink

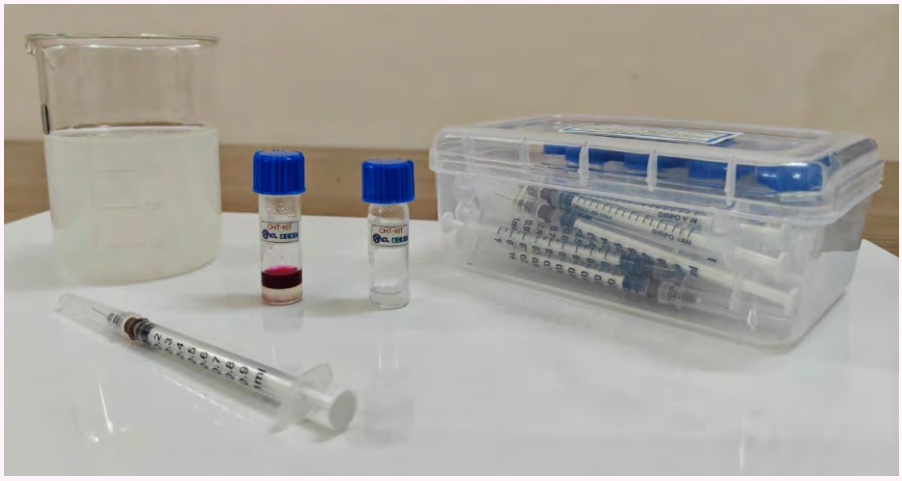
A simple colour change could save lives. Scientists at CSIR-NCL have developed the CHT-KIT, a rapid test that instantly turns pink when the dangerous chemical chloral hydrate is present in toddy, enabling quick detection and safer consumption.

Maharashtra has been grappling with a growing public health concern: the adulteration of toddy with a harmful chemical called chloral hydrate. As reports of tampering and health risks began to surface, scientists and officials intensified their efforts to address the problem. Recently in September 2025, authorities seized large quantities of this banned substance, uncovering its widespread misuse in tampering with toddy.

Traditionally, toddy is a natural drink collected from palm trees. It typically contains about 5–6% ethyl alcohol and has been safely consumed for generations. However, the addition of chloral hydrate turns it into a dangerous substance.

Once consumed, chloral hydrate converts in the body into trichloroethanol, a central nervous system depressant, and trichloroacetic acid, a corrosive compound. These can lead to severe health problems such as vomiting, ulcers, rashes, organ damage, loss of consciousness, coma, and even long-term carcinogenic effects. What was once a safe, natural drink had now become a serious public health risk.

But another challenge remained—how could officials quickly detect such adulteration? Earlier, testing required sending samples to laboratories or using complex instruments. This



process was slow and impractical for real-time enforcement.

Recognising this gap, scientists at CSIR–National Chemical Laboratory (CSIR-NCL), Pune, set out to find a simple solution. They asked a straightforward question: can adulteration be detected instantly, right at the point of sale?

After extensive research, they developed a small yet powerful tool—the CHT-KIT. Using the kit is simple. A small sample of toddy is taken, and a testing solution is added. If chloral hydrate (≥10 mg/L) is present, the liquid turns pink immediately. If there is no colour change, the drink is safe.

No machines. No waiting. Just a clear and instant answer.

The kit has been validated by the Forensic Science Laboratory and field-tested with excise officials, proving to be both accurate and easy to use. The technology has since been transferred to the Authentic Chemicals and Research Centre (ACRC-TEM) for commercial production, enabling its wider availability.

Today, toddy can be tested on the spot, making enforcement faster and more effective. Sellers are deterred from adulteration, and consumers can drink with greater confidence.

This story is a reminder that powerful solutions need not be complex. Sometimes, a simple colour change can make all the difference—protecting health, restoring trust, and saving lives.

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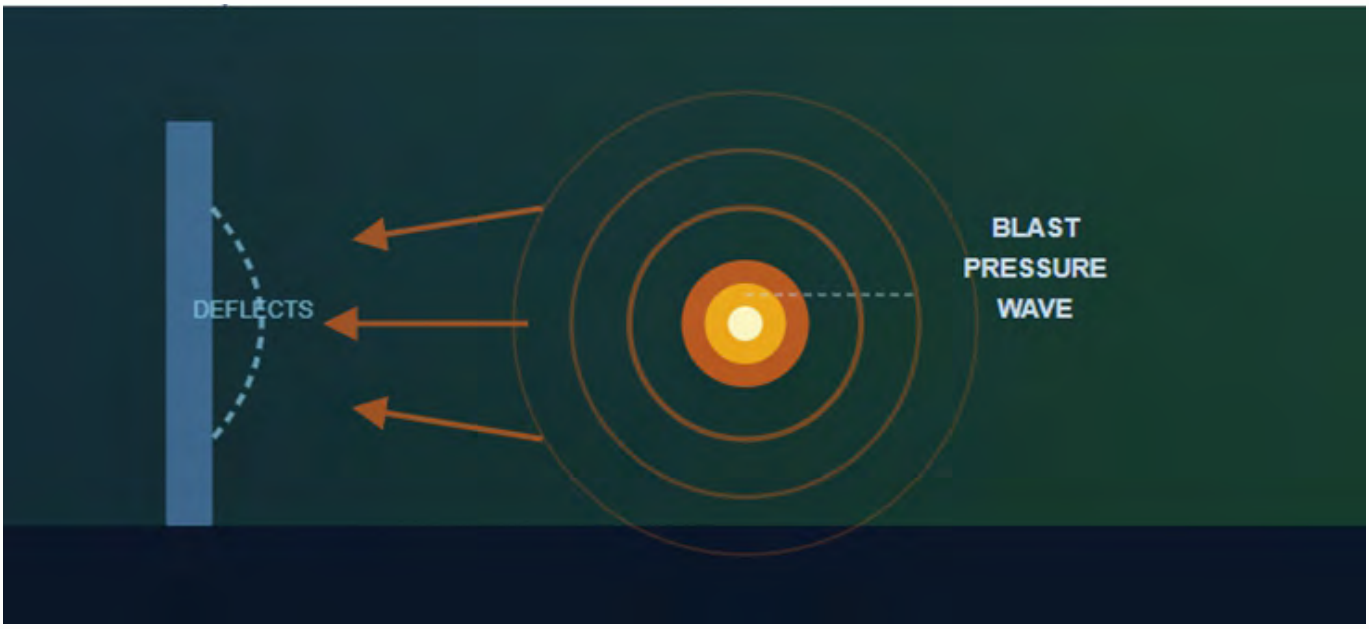
The Wall That Bends: India's New Science of Blast Protection

Explosions do not give structures time to react. In milliseconds, buildings must either absorb the energy or fail. Scientists at CSIR-SERC have developed a new blast-resistant system designed to bend without breaking—offering stronger protection with simpler construction for industries, defence infrastructure and cities.



A blast pressure wave being resisted by the system

Imagine a sudden explosion near a building. Not the fireball often shown in films, but the invisible force that follows—a fast-moving pressure wave. In fractions of a second, that wave can bend steel, crack reinforced concrete and trigger structural collapse. For engineers, the challenge is not simply building stronger structures. It is designing structures that can survive the shock. Because in blast protection, strength alone is often not enough. Sometimes, survival depends on the ability to bend.

Why Rigid Structures Can Fail

A common assumption is that safer buildings should be more rigid. But under extreme loading conditions, rigid materials can fracture suddenly. Engineers instead look for ductility—the ability of a structure to deform while continuing to carry load. Think of the difference between a dry biscuit and a flexible branch. One snaps quickly. The other bends before breaking.

For decades, India's blast-resistant structures relied heavily on Laced Reinforced Concrete (LRC), where dense networks of steel reinforcement are embedded within concrete. The system works, but constructing those reinforcement cages is labour-intensive and complicated. Even small mistakes during installation can weaken performance. Alternative steel-concrete composite systems improved strength but introduced another vulnerability: welding. The performance of the entire structure could depend on weld quality. Scientists at CSIR-SERC asked a different question: What if blast-resistant structures could eliminate welding altogether—and still become stronger?

The New Design: A Structure That Behaves Like a Woven Shield

The answer became the Laced Steel-Concrete Composite (LSCC) System, a patented technology developed by CSIR-SERC in India and the United States.

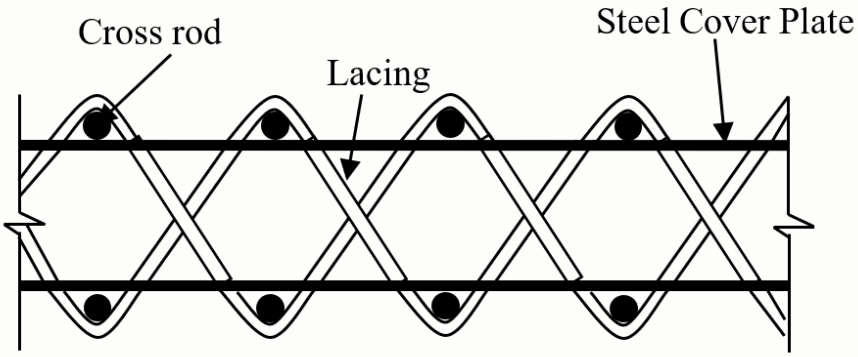
At first glance, the idea sounds simple. Imagine two steel plates facing each other with concrete filling the space between them. Instead of connecting these plates through welded joints, the LSCC system uses continuously bent steel rods—called lacings—woven through perforations and secured with cross-rods. The resulting structure behaves less like separate components and more like an interlocked network. This design changes how forces move through the material. Stress spreads continuously rather than concentrating at vulnerable points. And because welding disappears from the system, one major source of structural weakness disappears too.

The Numbers Behind Survival

Engineering breakthroughs ultimately depend on performance. One important measure in blast engineering is support rotation—how far a beam can bend before failure. Greater rotation means greater ability

to absorb energy. Conventional reinforced concrete beams tolerate around 3.5 degrees of support rotation. Existing laced reinforced concrete systems reach roughly 7 degrees. LSCC beams achieve 16 degrees.

That means they can deform dramatically while remaining functional—more than twice the capability of current blast-resistant standards and nearly five times that of ordinary reinforced concrete. The system also demonstrates three times higher cyclic ductility than laced reinforced concrete and loses only about 15% load-bearing capacity after peak loading, helping structures remain standing longer under extreme conditions. In practical terms, extra seconds of structural integrity may become extra seconds for evacuation.



Cross-section of Laced Steel-Concrete Composite System

From Beams to Protective Walls
Initially, researchers focused on beam-shaped components. Soon, a larger opportunity emerged: what if this technology could protect entire walls, floors and shelters? The result was the i-LSCC panel, a modular, factory-fabricated system capable of forming blast-resistant walls and protective enclosures. These precast units can be assembled rapidly, without on-site welding or complex reinforcement cages. The approach shifts part of construction from uncertain field conditions into controlled manufacturing environments—improving consistency and reducing dependence on specialised labour.

Where Could This Technology Matter?
The most immediate applications lie in defence infrastructure: ammunition storage facilities, protective shelters and sensitive installations exposed to blast risks. Mining operations could benefit too, where explosive use is routine and accidental blasts remain a concern. Industrial facilities handling hazardous materials may also find value in stronger protective systems. There is another possibility beyond intentional explosions.

Structures designed to absorb extreme energy often perform better under other dynamic loads as well. The same characteristics that improve blast resistance—ductility and energy absorption—can support retrofitting efforts for vulnerable buildings.

Rethinking Protection
Protective engineering has often followed a simple idea: build thicker walls. The LSCC approach suggests something more sophisticated.
Perhaps safer structures are not those that resist movement entirely.
Perhaps the safest structures are those designed to move, absorb energy and remain standing when failure seems unavoidable. Because sometimes, survival does not come from refusing to bend. It comes from bending just enough.

***

Flexural testing of i-LSCC panel

16°
Max support rotation — LSCC beams

3.5°
Max support rotation — conventional RC beams

3×
Cyclic ductility over Laced RC beams

15%
Max post-peak load drop under blast loading

Salt, Sun and Survival: How a Foldable House is Changing Life for the Agariyas of Kutch

In the vast salt deserts of Kutch, Agariya families endure extreme conditions to produce the salt that reaches millions of homes.A foldable shelter developed by CSIR-CBRI is bringing them safer, more comfortable and mobile housing.This simple innovation is transforming lives with dignity, resilience and hope.

Imagine living in a place where there are no trees, no shops, no schools, no neighbours and, in many places, not even a proper road.

Now imagine living there for eight months every year.

Welcome to the Little Rann of Kutch in Gujarat, a vast, shimmering landscape where the earth turns white with salt and the horizon seems to stretch forever.

This is the workplace and seasonal home of the Agariyas, a remarkable community of traditional salt workers who produce much of the salt used in Indian homes and industries. Every year, after the monsoon waters recede, thousands of Agariya families leave their villages and move deep into the salt desert to begin the long process of making salt.

It is hard work. And until recently, it meant living in shelters that could barely withstand the harsh desert conditions.

Today, however, a new innovation from CSIR–Central Building Research Institute (CSIR-CBRI), Roorkee, is helping bring safety, comfort and dignity to these unsung workers.

The People Behind India's Salt

India is one of the world's largest producers of salt, and Gujarat contributes nearly 80 per cent of the country's production. A significant portion of this comes from the Little Rann of Kutch, where Agariya families have practised salt-making for generations.

The word "Agariya" comes from the Sanskrit word agar, meaning salt pan. Each year, typically between October and June, Agariya families migrate from nearby villages into the Rann. They establish temporary settlements near their salt pans and spend the season pumping saline groundwater into shallow ponds. As the water evaporates under the intense sun, crystals of salt begin to form.

The work is physically demanding. Workers often stand ankle-deep in highly saline water for hours under temperatures that can exceed 45°C. Yet despite producing one of India's most essential commodities, many Agariya families live in extremely basic conditions.

When the Desert Floods

The Little Rann may appear dry and barren for most of the year, but during the monsoon it transforms dramatically. Large parts of the region become submerged under water. As the rains arrive, Agariya families dismantle their temporary camps and return to their villages. Any structures left behind are often damaged or washed away.

When the next season begins, they must once again rebuild their homes from scratch using bamboo poles, gunny sacks, plastic sheets and whatever materials they can afford. Strong winds, intense heat and occasional storms further shorten the lifespan of these makeshift shelters.

A House That Travels With Its Owners

Recognising the unique challenges faced by the Agariyas, scientists and

Developed foldable shelter

engineers at CSIR-CBRI developed a shelter specifically designed for migrant salt workers. At first glance, it looks like a compact house. But unlike a conventional house, this one can fold.

The shelter is built using a lightweight steel framework connected through specially designed hinges. When required, the structure can be folded into a compact form, transported to a new location and reopened with minimal effort. In essence, it is a house that travels with the family.

Built for the Salt Desert

The shelter has been designed to cope with the extreme conditions of the Rann. Its three-layer enclosure system provides insulation against intense daytime heat while also offering comfort during cooler nights. The outer covering is water-resistant, protecting occupants from rain and moisture. The interior fabric is fire-retardant, reducing the risk of accidents during cooking.

Strong anchoring arrangements help the structure withstand high winds common in open salt fields. Unlike conventional temporary huts made from plastic sheets, the foldable shelter is sturdier, safer and designed for repeated use over multiple seasons.

Wheels, Not Rebuilding

One of the most innovative features of the shelter is its mobility. The structure is equipped with wheels, allowing families to move it when work locations change. Instead of spending days dismantling and reconstructing a house, workers can simply relocate the shelter.

For communities that move frequently within the salt fields, this translates into savings of time, labour and money. More importantly, it reduces uncertainty and improves living conditions for entire families.

More Than a House

Although developed for Agariya salt workers, the technology has applications far beyond the salt pans of Kutch. The same foldable shelter can be used for disaster relief camps, emergency response operations, construction workers, migrant labour colonies, mobile healthcare units and temporary field stations.

Anywhere people need safe accommodation that can be quickly deployed and relocated, the shelter offers a practical solution.

A Small Innovation, A Big Difference

Every grain of salt on our dining table represents months of labour under one of India's harshest environments.

By developing a shelter tailored to their unique needs, CSIR-CBRI has done more than create a new structure. It has helped provide security, dignity and comfort to a community that has long worked at the margins.

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Why Your PNG Stove May Be Wasting Fuel—and How Scientists Fixed It

As millions of Indian households switch to Piped Natural Gas (PNG), an invisible problem is quietly wasting fuel in kitchens across the country. Scientists at CSIR-IIP have developed a dedicated PNG burner that delivers better efficiency, improved safety, and significant fuel savings—showing how a small change in design can have a large national impact.

India's kitchens are changing. Over the past decade, millions of households have been connected to Piped Natural Gas (PNG) networks through the rapid expansion of City Gas Distribution systems. PNG offers several advantages over LPG cylinders: there are no cylinder deliveries to wait for, no heavy cylinders to handle, and the fuel supply is continuous.

But as PNG entered Indian homes, an unexpected problem followed. Most households continued using LPG stoves that had simply been modified to run on PNG by replacing a small component called the injector. The solution seemed practical and inexpensive. Yet from an engineering perspective, it was far from ideal. The reason lies in the fuel itself.

Why PNG is Not Just LPG in a Pipe

Although both fuels are used for cooking, LPG and PNG behave very differently. LPG consists mainly of propane and butane, while PNG is predominantly methane. They burn differently, require different air-fuel mixtures, and operate at different supply pressures. In simple terms, a stove designed for LPG is like a car engine designed for one fuel but forced to run on another. It may work—but not efficiently.

When LPG stoves are retrofitted for PNG use, several problems can emerge. Fuel and air may not mix properly, flames can become unstable, and combustion may remain incomplete. As a result, more fuel is consumed to achieve the same cooking task. In some cases, a phenomenon known as **flame lift** can occur, where the flame partially separates from the burner surface instead of remaining anchored where it should. This affects both performance and safety.

Scientists at CSIR-Indian Institute of Petroleum (CSIR-IIP), Dehradun, saw this challenge as an opportunity.

Designing a Burner Specifically for PNG

Rather than modifying LPG stoves, the researchers of CSIR-IIP have developed PNG Burner, an indigenous technology developed using combustion science, computational modelling, laboratory testing, and field trials. Every component of the burner was optimized for methane-rich PNG. The gas injector, mixing tube, burner head, air-entry system, and flame ports were all redesigned to create the right fuel-air mixture and maintain a stable flame. The goal was straightforward: extract more useful heat from every unit of gas consumed.

A Small Flame with a Big Impact

The results were impressive. The CSIR-IIP burner achieves thermal efficiencies exceeding 68 percent, meeting the requirements of BIS Standard IS 17153:2019. Compared with retrofitted LPG burners operating on PNG, it can reduce fuel consumption by approximately 20–25 percent while delivering comparable cooking performance.

For a household, the difference may appear modest. For a country with millions of PNG consumers, the impact becomes enormous. Researchers estimate that widespread adoption of dedicated PNG burners could save thousands of crores of rupees annually while significantly reducing natural gas consumption. The technology also has the potential to reduce carbon dioxide emissions by nearly one million tonnes every year.

Domestic Cook-stove with CSIR-IIP burner

From Laboratory Research to Indian Homes

Many innovations remain confined to research papers. This one has already reached the market. The technology has been licensed to 42 stove manufacturers across India, including well-known brands. More than 10,000 PNG stoves based on the CSIR-IIP design have already been sold and deployed in households. Major city gas distribution companies have also shown interest in promoting the technology. To ensure quality and authenticity, CSIR-IIP even developed a QR-code-based verification system that allows consumers to identify genuine PNG stoves based on the technology.

More Than Fuel Savings

The significance of the innovation extends beyond individual kitchens. India imports a substantial portion of its energy requirements. Every percentage improvement in efficiency reduces pressure on energy supplies and lowers greenhouse gas emissions. Fuel saved in homes can be redirected toward transportation, industry, and fertilizer production—sectors where natural gas plays a critical role.

The technology is also creating opportunities for Indian manufacturers. With dozens of licensed producers and a growing PNG market, the burner is helping strengthen domestic manufacturing under the Make in India initiative.

The Future of Clean Cooking

The next phase is not about proving the technology works—it already has. The challenge now is awareness. Many PNG users remain unaware that a dedicated PNG burner can perform significantly better than a modified LPG stove. As city gas networks continue expanding across India, technologies such as the CSIR-IIP PNG burner could play an important role in making clean cooking not just convenient, but also more efficient and sustainable. Sometimes, technological revolutions do not arrive as giant machines or towering infrastructure projects. Sometimes, they arrive quietly—in the form of a better flame.

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Scan to know more

Retrofitted LPG burner with PNG firing

TRIVIA TIME

Q1. What is the main advantage of MSS+ technology compared to conventional road surfacing methods?
A). It requires higher temperatures during construction
B). It eliminates the need for heating bitumen and aggregates
C). It uses only concrete materials
D). It requires specialized imported machinery

Q2. Which of the following natural materials is mentioned as a reinforcement fibre in Natural Fibre Reinforced Plastics (NFRPs)?
A). Steel wool
B). Carbon fibre
C). Rice husk
D). Fiberglass

Q3. What is the primary function of the AI-Integrated Line Source Emission Inventory (AI-LSEI) dashboard developed by CSIR-NEERI?
A). Detect traffic violations automatically
B). Monitor weather conditions in cities
C). Convert CCTV feeds into real-time pollution maps
D). Control traffic signals remotely

Q4. Which CSIR laboratory developed the CHT-KIT for instant detection of toddy adulteration?
A). CSIR-Central Road Research Institute
B). CSIR-National Environmental Engineering Research Institute
C). CSIR-Indian Institute of Chemical Technology
D). CSIR-National Chemical Laboratory

Q5. One key benefit of Joint-Free bridges developed by CSIR-SERC is:
A). Reduced traffic congestion
B). Lower fuel use
C). Smoother rides
D). Lower toll charges

Q6. Where is the LSCC system most suitable for deployment?
A). Defence shelters and ammunition storage facilities
B). Shopping malls and retail outlets
C). Railway station platforms
D). Public garden landscaping

Q7. Which CSIR institute successfully introduced and standardised peony cultivation in India for the first time?
A). CSIR-NCL, Pune
B). CSIR-IHBT, Palampur
C). CSIR-NEERI, Nagpur
D). CSIR-SERC, Chennai

Q8. What major benefit does the CSIR-IIP PNG burner provide compared to retrofitted LPG burners?
A). It increases gas consumption
B). It eliminates the need for pipelines
C). It reduces fuel consumption by about 20–25%
D). It works only in industrial kitchens

Q9. Which two traditional tanning steps are eliminated in the Waterless Chrome Tanning Technology developed by CSIR-CLRI?
A). Cleaning and drying
B). Pickling and basification
C). Dyeing and polishing
D). Washing and finishing

Q10. What does UCCW stand for?
A). Urban Clean City Waterway
B). Up-flow Compact Constructed Wetland
C). Unified Circular Clean Water System
D). Underground Compact Conservation Wetland

Q11.How is machine learning helping scientists at CSIR-NCL develop better hydrogen storage materials?
A). By manufacturing metal hydrides automatically
B). By replacing laboratory experiments completely
C). By quickly identifying promising material combinations from millions of possibilities
D). By generating hydrogen directly from water

Q12. What unique feature makes the shelter developed by CSIR-CBRI especially useful for Agariya families?
A). It generates electricity from salt
B). It can float on floodwater
C). It can be folded, transported, and reused easily
D). It is built entirely from bamboo

Answers
1) B 2) C 3) C 4) D 5) C 6) A 7) B 8) C 9) B 10) B 11) C 12) C

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