Council of Scientific and Industrial Research (CSIR)

Latest Innovation and Technological Development – November 2025

Title of Technology/ Innovation	Brief Description about the technology/ Innovation	If patented (Yes/ No) with patent number	Technology Readiness Level (1-9)	Benefits	Potential Applications	Picture videos, if any showcasing the technology (weblink)
Fermentation based Technology Development for Biodegradation of Ammonium Perchlorate	Provided below	Under process	**Level 6** **Justification:** The biodegradation process has been successfully demonstrated at pilot scale (500L fermenter) under relevant operational conditions, confirming its effectiveness, scalability, and readiness for industrial implementation trials.	Provided below	Provided below	Provided below

Brief Description about the Technology:

The project, jointly carried out by **CSIR–Institute of Microbial Technology (CSIR-IMTECH)** and **ISRO–Vikram Sarabhai Space Centre (VSSC)**, focused on developing a **sustainable and eco-friendly biotechnological process** for the **biodegradation of Ammonium Perchlorate (AP)**, a major oxidizer used in solid rocket propellants. From the developed microbial consortium, a **pure single isolate** was identified as the most efficient strain capable of rapidly degrading high concentrations of AP. The process was systematically optimized for media composition, nutrient feed, and operational parameters, and successfully **scaled up from 5L to 500L fermenter levels**, achieving **degradation of 10,000 ppm AP to below 2 ppm within 24 hours** under controlled fed-batch conditions. This innovative microbial-based technology offers a green, cost-effective, and scalable solution for the safe and efficient treatment of AP-containing effluents generated in aerospace.

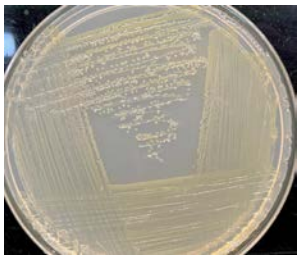
Benefits:

1. **Eco-friendly and Sustainable:** Utilizes natural microbial processes instead of harsh chemical or thermal treatments, reducing environmental pollution and promoting green waste management.
2. **Highly Efficient:** Capable of degrading high concentrations of ammonium perchlorate (10,000 ppm) to safe levels (<2 ppm) within 24 hours, ensuring rapid detoxification.
3. **Cost-effective:** Minimizes operational costs by using biological degradation
4. **Scalable Process:** Successfully demonstrated from laboratory (5L) to pilot-scale (500L) fermenters, proving industrial applicability and robustness.
5. **Safe for the Environment:** Converts perchlorate compounds into harmless end products, reducing health and ecological risks.
6. **Supports Strategic Sectors:** Offers a sustainable solution for waste management in aerospace particularly for ISRO and related establishments handling solid rocket propellants.

Potential Applications:

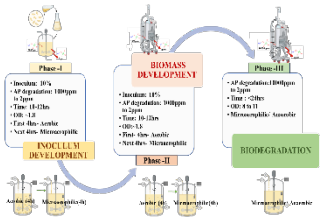
1. **Aerospace and Defense Industries:** Treatment of waste streams containing perchlorate generated during the production, testing, and disposal of solid rocket propellants**.**
2. **Environmental Remediation:** Bioremediation of soil and groundwater affected by perchlorate compounds**.**
3. **Industrial Effluent Treatment:** Integration into effluent treatment plants (ETPs) of chemical, explosive, and pyrotechnic industries where perchlorate is used or produced**.**
4. **Research and Development:** Further application in developing microbial systems for biodegradation of other hazardous oxidizers and explosives**.**
5. **Sustainable Waste Management:** Adoption as a model green technology for large-scale biological treatment of industrial wastes, supporting national environmental and safety goals.

Pictures:



A. Isolated culture 'O1' with highest AP degradation efficiency

B. Degradation of AP at lab scale



C. Process development

D. Scale-up in 5 L fermenter

E. Scale-up in 50 L fermenter

F. Scale-up in 500 L fermenter

G. Successful completion of project at CSIR-IMTECH and meeting at ISRO, VSSC

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IIT-Roorkee

Latest Innovation and Technological Development – November 2025

Sl. No.	Title of Technology/Innovation	Brief Description about the technology/Innovation (including details about the innovator/developer)	If patented (Yes/No) with patent number	Technology Readiness Level (1-9)	Benefits	Potential Applications	Pictures/Videos, if any showcasing the Technology (Weblink)
1.	A perovskite based alpha particle detector for monitoring radon progeny and a portable system employing the same	The invention discloses a novel portable system for monitoring of air borne Radon Progeny in confined environment which is based on Perovskite Alpha Particle Detector. The Aluminium Alloy casing of this system contains a novel integration of Perovskite detector, Diaphragm pump based Air ingress HEPA filtration system, 2048 MCA and microcontroller based data acquisition system. This system is powered by Lithium ion rechargeable batteries. Detector comprising of CsPbBr3 perovskite film of thickness 90 nanometres – 100 micrometres is deposited on GaAs semiconductor and Silicon substrate. This also has provision of Wi-fi which allows data transmission and remote monitoring of Radon progeny.	Yes Application no.: 202511082940	**3**	This system has a provision of Wi-fi which allows data transmission and facilitates the remote monitoring of air borne Radon progeny in confined environment. This system is portable, easy to operate, user friendly, easily to establish, low maintenance and economical. The solution is highly environment friendly as it deploys rechargeable lithium ion batteries for powering up the system, and also the detector consists of environment friendly perovskite films. This solution brings down	• This solution can be deployed for civil as well as military installations where there is need to monitor radon progeny concentrations such as Uranium mines, underground facilities etc. • The present invention deploys novel Perovskite semiconductor based Alpha particle detector which has outstanding charge transport properties, high stability and good attenuation efficiency making it commercially viable next generation semiconductor based detector. • This system also has a provision of Wi-fi which allows data transmission and facilitates the remote monitoring of air borne	**https://drive.google.com/drive/folders/1xORSFmLxBjENG_IuMl67_X3vO8b3RMB6?usp=sharing**

		Inventors: Rakesh Kumar, Anil Kumar Gourishetty and Mohak Ketan Patil			the overall carbon footprints.	Radon progeny in confined environment. • This system is portable, easy to operate, user friendly, easily to establish, low maintenance and economical. • The solution is highly environment friendly as it deploys rechargeable lithium ion batteries for powering up the system, and also the detector consists of environment friendly perovskite films. This solution brings down the overall carbon footprints.	
2.	Wearable cooling system	The present disclosure discloses a wearable cooling system. The system includes integration of thermoelectric cooling modules with a wearable accessory, where the thermoelectric cooling modules include a heat absorption end and a heat dissipation end. Liquid coolant blocks are thermally coupled to the heat dissipation end. A liquid circulation pump is fluidly coupled to the liquid coolant blocks and a heat exchanger to form a closed-loop circuit. The system is adapted to receive thermal energy, via the heat absorption end and enable, transfer of the absorbed thermal energy. The system heats the liquid coolant and	Yes Application no.: 202511088179	**3**	The present invention provides a system capable of continuous, long duration cooling by using an active, closed-loop liquid cooling circuit, overcoming the limitations of systems with finite heat sinks. It provides a highly energy-efficient solution by primarily using motion-generated ambient airflow for heat dissipation.	The present invention relates a system for providing continuous cooling to a user of a vehicle via a portable, wearable accessory.	**https://drive.google.com/drive/folders/1gi_2W2PNA5qRi9NBzXsABcwiaKGS4kZM?usp=sharing**

		circulates the heated liquid coolant through the closed-loop liquid circuit to the heat exchanger. The system enables return of the liquid coolant, after being cooled, to the liquid blocks for continuous thermal energy absorption. **Inventors:** Ankit Bansal, Ayush Pradip, Jain Arul Amit, Pranav pardeshi and Anubhav Maity			It offers a dual-mode operation that ensures cooling effectiveness both when the user moving and when stationary, enhancing its practical usability. It offers a fully self-contained, portable, and battery powered system that does not depend on a vehicle's engine for power. It also provides smart control features through microcontroller and wireless connectivity, allowing for real-time user adjustment of the cooling level.		
3.	System and method for real-time vehicle occupancy monitoring and alert generation	Disclosed is a system for monitoring vehicle occupancy in real-time. The system includes at least one imaging unit disposed over at least one door of a vehicle for capturing real-time images or videos. A location tracking unit obtains real-time location and corresponding time. An edge device with a processing unit receives the real time images or videos, the real-time location data and the time, and processes the images or videos, determines passenger entry/exit	Yes Application no.: 202521075676	**4**	The technology ensures accurate, real-time passenger counting and alert generation, improving fleet management and passenger safety. It reduces bandwidth needs through edge processing, detects tampering for system integrity, and supports dynamic vehicle scheduling based on occupancy trends.	The system integrates imaging units over vehicle doors with a location tracking unit and an edge device to capture and process real-time images, location, and speed data. It determines passenger entry and exit events to calculate real-time occupancy, while the central processing apparatus analyzes this data to identify occupancy patterns and generate	https://drive.google.com/drive/folders/1SJ0-cMfP113kR5W4Pwanlhwoye JJwG6s?usp=sharing

		events, and calculates real-time occupancy count. An information processing apparatus with processing circuitry receives the occupancy count and location data, generates alerts based on vehicle conditions and occupancy levels, and identifies occupancy patterns. The system further includes a local database at a vehicle depot for storing data, and an interface for notifying the vehicle managing authority about alerts. **Inventors:** Amit Agarwal, Karthik Krishnan O and Ritesh Singh			Overall, it enhances operational efficiency, minimizes downtime, and enables data-driven decision-making in public transport management.	alerts for breakdowns, off-route movement, idling, or overcrowding. A local database at the vehicle depot enables automatic transfer and storage of video files for monitoring and analysis.	
4.	A transition structure from a microstrip line to an empty substrate integrated waveguide (ESIW)	The present disclosure provides a transition structure from a microstrip line to an empty substrate integrated waveguide (ESIW) that incorporates a metallized stepped dielectric profile protruding into the ESIW. This profile may be designed and manufactured with relative ease, and may be suitable for use with thinner substrates. The transition structure may function as a DC short, potentially making it applicable for various devices such as mixers, frequency multipliers, and detectors. The structure may be adaptable, allowing for redesign to operate over different frequency bands as needed. Unlike some prior designs, this structure may not require additional vias on both sides of the dielectric	Yes Application no.: 202511077657	**4**	The transition structure provides wide fractional bandwidth exceeding 70%, low insertion and return loss, and simplified fabrication without additional vias. Its metallized stepped dielectric profile ensures efficient impedance matching, reduced dielectric losses, and structural reliability. The design enhances signal integrity, enables miniaturization, and improves overall performance in	The disclosed transition structure from a microstrip line to an empty substrate integrated waveguide (ESIW) is applied in high-frequency microwave and millimeter-wave systems to enable efficient signal transfer between planar microstrip circuits and low-loss ESIW structures. It is suitable for integration in RF and communication systems, including telecommunications, aerospace radar, and consumer electronics, where compact, high-	https://drive.google.com/drive/folders/1EnZXiyQnyW6Rz0iQVicpruxMlyygW4XL?usp=sharing

		profile. These features may contribute to improved performance and flexibility in high-frequency applications, while potentially simplifying the manufacturing process. **Inventors:** Rishi Raj Singh and Akhilesh Mohan			microwave and millimeter-wave applications.	performance, and wideband signal routing is required.	
5.	A system and a method for managing power distribution	The present disclosure provides a system for managing power distribution in a geographic region. The system comprises a power generation unit implemented in the geographic region, a power monitoring unit communicatively coupled to the power generation unit and configured to measure power generated by the power generation unit in real-time, at least one sensor implemented at the geographic region and configured to measure temperature at the geographic region, and a control unit communicatively coupled to the power monitoring unit and the at least one sensor. The control unit is configured to ascertain the power generated based on the measurement by the power monitoring unit, ascertain the temperature based on the measurement by the at least one sensor, and distribute the power to at least one load from a plurality of loads based on at least one of the power generated and the measured	Yes Application no.: 202511081270	**4**	The system ensures optimum utilization of available power, provides autonomous operation without manual intervention, and adapts to seasonal variations. It supports complete offline operation, prevents power wastage, and promotes sustainable rural development through intelligent energy management.	The system for managing power distribution is applied in remote and hilly regions using renewable hydropower generation units. It enables temperature-responsive and priority-based power allocation to essential loads like cold storage and hot water systems, flexible loads such as cottage industry units, and optional domestic loads for efficient rural electrification.	https://drive.google.com/drive/folders/1Ep2VZwb96cAxaKNdzAD55B_Kk22MjmmV?usp=sharing

		temperature. The power generation unit comprises a water mill-based hydropower system, and the plurality of loads includes temperature-dependent loads such as cold storage systems and hot water systems. **Inventors:** Sunil Kumar Singal, Manish Mishra, Imtiyaz Ali, Sonal Keshawrao Thengane and Varun					
6.	A multi-pass helical submerged membrane distillation module for desalination wastewater treatment and method thereof	The present invention relates to a multi-pass helical submerged membrane distillation module for desalination and wastewater treatment. The module comprises a cylindrical brass shell incorporating inner and outer helical flow channels covered with hydrophobic membranes supported by spacers. The brass shell construction enhances thermal conductivity and minimises temperature polarisation, while the helical geometry increases residence time and promotes turbulence. The integrated spacer arrangement further reduces fouling and scaling, ensuring operational stability. A unique feature of the invention is its ability to function in direct contact and vacuum membrane distillation modes without requiring structural modifications. This dual-mode adaptability makes the system highly versatile for different operating environments. The compact and modular design	Yes Application no.: 202511089125	**4**	The brass helical shell enhances heat transfer and reduces temperature polarisation, while hydrophobic membranes with polypropylene spacers minimise fouling. The module achieves flux above 5 kg/m²h, rejection over 98%, low energy use, and long-term stable, modular, and leak-proof operation.	The multi-pass helical submerged Membrane Distillation (MD) module is used for desalination and wastewater treatment, operating in Direct Contact (DCMD) and Vacuum Membrane Distillation (VMD) modes without structural modification for saline, textile, and pharmaceutical wastewater.	https://drive.google.com/drive/folders/15RVSdKQLsjh8QryDInp1nofpk7at-b0w?usp=sharing

		facilitates ease of assembly, scalability, and integration with renewable or waste heat sources. The invention provides an energy-efficient and robust solution for purifying saline water, textile wastewater, pharmaceutical effluents, and other contaminated streams. **Inventors:** Anshul Yadav, Bal Krishan, Nikhil and Pawan Kumar Labhasetwar					

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