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"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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PREFACE

It is with great pleasure that we present the e-proceedings of International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), which compiles the extended abstracts submitted to the International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), held on 23 January 2025 at **PTDI, Universiti Teknologi MARA (UiTM) Cawangan Johor, Kampus Pasir Gudang**. This publication serves as a valuable resource, showcasing the intellectual contributions on the invention and innovation among students, academics, researchers, and professionals.

The International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), organized under the theme "Fostering a Culture of Innovation and Entrepreneurial Excellence," is designed to inspire participants at various academic levels, from secondary students to higher education students and professionals. The competition emphasizes both innovation and entrepreneurship, encouraging the development of product prototypes that address real-world problems and have clear commercialization potential. By focusing on technological and social innovations, i-TIEC 2025 highlights the importance of turning creative ideas into viable, market-ready solutions that can benefit users and society. The extended abstracts in this e-proceedings book showcase the diverse perspectives and depth of research presented during the event, reflecting the strong entrepreneurial element at its core.

We extend our sincere gratitude to the contributors for their dedication in sharing their innovation and the organizing committee for their hard work in ensuring the success of the event and this publication. We also appreciate the support of our collaborators; Mass Rapid Transit Corporation Sdn. Bhd. (MRT Corp), Universitas Labuhanbatu, Indonesia (ULB), Universitas Riau Kepulauan, Indonesia (UNRIKA) and IEEE Young Professionals Malaysia, whose contributions have been instrumental in making this event and publication possible.

We hope that this e-proceedings book will serve as a valuable reference for researchers, educators, and practitioners, inspiring further studies and collaborations in both innovation and entrepreneurship. May the knowledge shared here continue to spark new ideas and market-ready solutions, advancing our collective expertise and fostering the growth of entrepreneurial ventures.

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A-ST140: ROOF SPRINKLER COOLING SYSTEM USING GREYWATER RECYCLING

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ABSTRACT

An inventive and environmentally friendly solution to urban cooling, water management, and environmental issues is the roof sprinkler cooling system that recycles greywater. Through roof-mounted sprinklers, the system provides evaporative cooling using treated greywater from domestic sources including sinks and showers. This procedure conserves fresh water, lowers indoor temperatures, and lessens the impact of the urban heat island. The technology reduces dependency on energy-intensive air conditioning while addressing excessive wastewater and high-water consumption in hot, humid countries like Malaysia. It is designed to mimic natural evaporative cooling. This system's main advantages include lower energy use, water saving, and improved environmental sustainability. It reduces greenhouse gas emissions by reducing energy demand and encourages the use of greywater for non-potable uses as part of a circular water management concept. Increased public awareness of sustainable behaviors, less strain on water supplies, and better urban microclimates are just a few of the socio-environmental benefits. Scalability and compliance with green building certifications improve the system's chances of being commercialized in both the residential and commercial markets. Because it may address important environmental issues, it is a useful and effective way to promote sustainable urban growth.

Keywords: Sustainable Cooling Systems, Greywater Recycling, Evaporative Cooling, Water Conservation Technology, Energy-Efficient Cooling Solutions

1. Product Description

The creative greywater recycling roof sprinkler cooling system is a sustainable alternative that uses treated household wastewater to increase cooling efficiency while preserving fresh water. It works by piping the recycled greywater, collected from showers, sinks, and washing machines, through a series of sprinklers mounted on the roof of the building. Spraying decreases the indoor temperature due to a phenomenon whereby heat is taken away from the roof surface and water evaporation occurs. Surrounding cooling through evaporative processes reduces the urban heat island effect. This approach reduces wastewater output and the reliance on conventional energy-intensive air conditioning, in tune with the guiding principles of a circular water management regime. The concept of greywater recycling in the cooling process addresses key environmental concerns: excessive water use, high energy consumption, and urban heating. Therefore, this invention would be feasible for green buildings in Malaysia and other countries that have hot and humid climates.

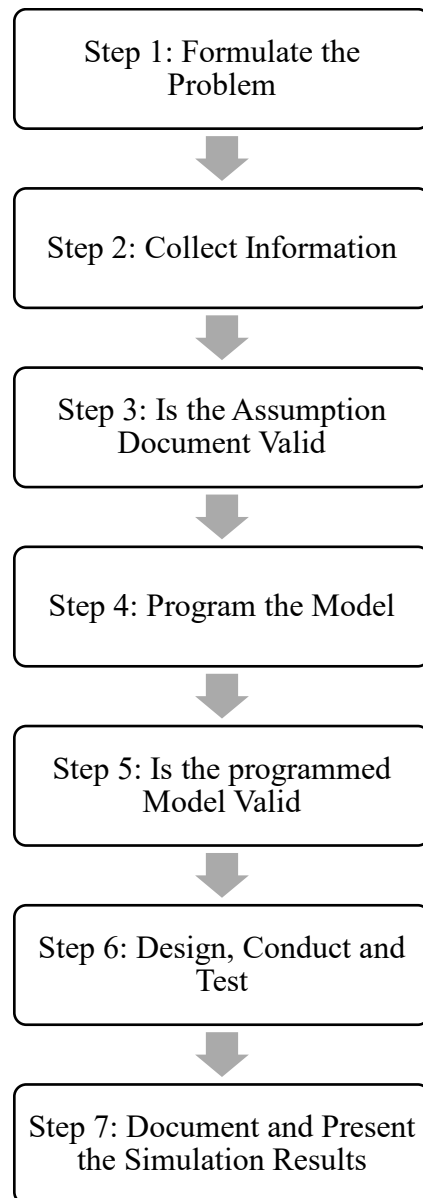
2. Pictures/ Schematic diagrams/ Flow Charts/Screenshots/Graphs/Table and etc .

Figure 1. Flowchart of the Research Process

Figure 1 shows the research process involves formulating the problem by defining the goals of evaluating a greywater-based roof sprinkler cooling system, such as optimizing design, cooling effectiveness, and water efficiency. Information is then collected, including technical and environmental data, and assumptions about system performance are validated. A 3D model is created using Autodesk Revit, followed by validation through comparison with real-world data. Simulations are conducted to test the system under various conditions, identifying optimal design parameters for cooling performance. Finally, results are

documented in a report with recommendations for further research and practical applications in sustainable building practices.

Table 1. Comparison between the old traditional system and Roof Sprinkler Cooling System using Greywater Recycling

<i>Features</i>	<i>Traditional Passive Cooling</i>	<i>Roof Sprinkler Cooling System using Greywater Recycling</i>
<i>Performance</i>	Depends on ambient air or shade; works well in temperate settings but erratically in hot weather.	Uses evaporative cooling to deliver steady cooling, even in extremely hot conditions.
<i>Environmental Impact</i>	Energy-free and sustainable, although only partially effective under severe weather conditions.	It is very sustainable because it uses recovered greywater, uses less energy, and has a smaller carbon footprint.
<i>Installation</i>	Low installation cost but depends on building design and environmental conditions.	Higher initial installation cost at first.
<i>Maintenance</i>	Minimal maintenance	Low ongoing maintenance, requiring occasional pump and sprinkler checks.
<i>Cost Efficiency</i>	No recurring expenses, but in hotter climates, extra cooling techniques would be needed, raising long-term expenses.	Long-term savings are provided by a higher initial cost but decreased energy and water expenditures.
<i>Thermal Comfort</i>	Comfortable in mild weather, but may not be sufficient in hot weather.	Enhances indoor comfort even under intense heat by actively cooling the building.
<i>Marketability</i>	Marketed to eco-aware people looking for affordable alternatives in temperate climes.	Offering energy and water savings, this product is highly marketable in hot locations with limited water supplies, appealing to sustainable building trends.

3. Novelty and uniqueness

The novelty and uniqueness of the roof sprinkler cooling system using greywater recycling lie in its holistic approach to solving three very important environmental concerns: urban heat management, energy efficiency, and water scarcity. This system contributes to sustainable water management by reducing dependency on potable water through reusing greywater from sinks, showers, and washing machines. While its design, on the other hand, taps into the natural process of evaporative cooling to reduce inside temperatures and diminish the impact of the urban heat island by spraying treated greywater onto roofs. This invention combines for the first time passive cooling with water conservation and decreases the demand for traditional air conditioning use significantly, reducing energy use and the resulting GHGs. The system will be promoting water management in a circular way through reuse of domestic wastewater as a resource, supporting the SDGs and green building concepts. The adaptability of the concept to different building types and climates, especially in hot and humid countries like Malaysia, increases its viability and market potential. It is one of the innovative developments in environmental-friendly building technologies due to the clever integration of cooling mechanisms together with greywater treatment, storage, and distribution, which comes up with a sustainable and economical solution.

4. Benefit to mankind

The greywater recycling roof sprinkler cooling system saves humanity in many ways, positively contributing to two of the critical environmental and sustainability concerns. In arid regions, greywater can be reused originating from household washing and bathing and reduce the use of potable water. With less dependence on air conditioning to keep cool, electricity is saved while lowering greenhouse gas emissions. It also contributes to the mitigation of the urban heat by cooling roof surfaces, which consequently lowers surrounding air temperatures and reduces the urban heat island effect. Also, recycling greywater reduces untreated wastewater discharge into the environment, hence reducing pollution and easing pressures on sewage treatment plants. This new technology meets SDGs by ensuring responsible consumption of water, reducing energy expenses, and providing better thermal comfort for building occupants. Its integration into green building practices makes it practical and impactful in hot, humid climates, further enhancing environmental and human well-being.

5. Innovation and Entrepreneurial Impact

The creative roof sprinkler cooling system using greywater recycling responds to some key environmental challenges like energy efficiency, water conservation, and management of the urban heat island effect, thereby stimulating innovation and an entrepreneurial impact. This technology lessens dependence on traditional air conditioning and the use of freshwater by making wastewater a useful commodity. It helps Malaysia's drive for climate-resilient urban development and is in line with international green building standards that call for sustainable living. This gives the chance to local businesspeople to further adapt and commercialize the technology, perhaps creating new water-recycling and sustainable cooling system businesses. It opens up avenues of academia-business partnerships for improvement and scaling of the

innovation to assist in the community and construction sectors for building a problem-solving culture.

6. Potential commercialization

The greywater recycling roof sprinkler cooling system is highly commercializable, especially for its sustainability, cost-effectiveness, and flexibility. These meet the demand for sustainable solutions in the heart of urban centers-especially for hot, humid countries like Malaysia. This reduces energy consumption and greenhouse gas emissions by reducing conventional air conditioning demand while reusing household greywater for cooling. This system is especially attractive to residential and commercial developers looking for green building certifications and sustainable development. In the increasing awareness of water conservation and energy efficiency, this system's potential for reduction in water waste and urban heat island effect makes it a very bankable product in the global market. Its adaptability to various building types and climates further enhances its market appeal, making it a promising solution for sustainable urban living.

7. Acknowledgment

This research was supported by Universiti Teknologi MARA (UiTM) and guided by an academic supervisor. Special thanks to the 2nd International Tinker Innovation & Entrepreneurship Challenge (I-TIEC 2025) committee for establishing a forum where students can network and exchange expertise.

8. Authors' Biography



Nurin Afrina Muhammad Ruslan is a dedicated student currently in her sixth semester at Universiti Teknologi MARA (UiTM), Seri Iskandar, Perak. With a strong passion for sustainable development and innovative solutions, she has focused her academic journey on addressing environmental challenges in urban areas. Nurin is actively involved in research and development projects, including the creation of a roof sprinkler cooling system using greywater recycling, an eco-friendly innovation aimed at reducing energy consumption, conserving water, and mitigating urban heat island effects. This project reflects her commitment to integrating technology and sustainability, making a positive impact on both local and global communities. As she continues her studies, Nurin aspires to further advance sustainable practices in building systems and environmental management.



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