





CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA



Rewastec

-  Phatumthani Province, Thailand
-  Plastic and rubber products
-  www.facebook.com/Rewastec/
-  Analysis period: 2020-2023

Composite Materials from Agricultural Waste and Recycled Plastics

Business Spotlight

The startup Rewastec Company Limited addresses two significant environmental issues – the disposal of plastic waste and the open burning of agricultural waste. The company's innovation combines these two waste challenges to create high-quality compound plastic pellets and filaments. By producing 3,500 kg of recycled plastic composite pellets, between 2023 and June 2024, Rewastec prevented 3,000 kg of plastic waste from being landfilled. Additionally, 542 kg of agricultural waste was reused to mix in with plastic waste, which was thus diverted from open burning thereby reducing associated air emissions, including PM2.5. Rewastec's business strategy focuses on outsourced manufacturing through Original Equipment Manufacturers (OEM) in, for example, the telecommunications sector, to scale-up product sales to 30 metric tonnes of recycled plastic composite pellets per month. The company expects to reach cost recovery by 2027.

Keywords

Agricultural waste, Plastics recycling

Innovation

End-of-life management, Product design, Manufacturing, Resource circularity



Context and baseline

In Thailand, plastic waste generation in 2018 was estimated at 2 million metric tonnes, of which only 0.5 million metric tonnes was reused and/or recycled annually. As a result, 1.5 million metric tonnes of plastic waste ended up in landfills or leaked into the environment.¹ The recycling primarily involves Polyethylene Terephthalate (PET), Low-Density Polyethylene (LDPE) and High-Density Polyethylene (HDPE) plastics. These recyclable plastics have strong texture, high impact resistance and require a low forming temperature.

The open burning of agricultural waste, such as rice straw, bamboo leaves and coconut husks, is a major contributor to poor ambient air quality in various regions of Thailand. Despite open burning being illegal, many farmers resort to it because of financial and time constraints. Alternative methods for crop residue management, such as collection, or field composting and plowing it back into the soil are available but are costly and time-consuming, and are thus not adopted as farmers fear the consequent decrease in earnings would adversely impact their livelihoods.²

Wisarat Chalee, the CEO and Founder of Rewastec, did his master's thesis at Suranaree University of Technology on developing polymer composites with LDPE and rice straw fibres, which laid the groundwork for establishing Rewastec. His research identified nanomaterials as highly efficient for reinforcement of plastics but prone to agglomeration. He found that adding natural micro-fibre from rice straw helps disperse nanofibres (from LDPE) evenly through the final composite material matrix, improving the composite's overall properties. Chalee decided to establish Rewastec with the sole purpose to commercialise this innovation.

Rewastec innovates the recycling process to produce more valuable composite materials, and offers a sustainable alternative to crop-waste burning. This aligns with broader environmental goals and contributes to solving a pressing public health issue related to poor ambient air quality.

Innovation

Rewastec Company Limited has developed a unique method to compound crop residue with plastic during the recycling process – an innovation in recycled plastics product development.

The company's recycling and compounding process involves the following steps, each carried out by Rewastec except for pellet production.

1. Collection and sorting of LDPE plastic waste: Rewastec collects used LDPE, HDPE and Poly Propylene (PP) plastic from various sources, including industrial plants, communities and hospitals. This plastic waste is then sorted by type and colour, and the plastic waste is also size-reduced, i.e. ground into small pieces to allow for mixing with the agricultural materials. The company sources plastic waste from Nakhon Ratchasima province and has partners in other northeastern provinces of Thailand who can supply the company with the waste.
2. Preparation of agricultural waste materials for mixing: Rice straw and other natural materials such as bamboo leaves, coffee grounds and sugarcane bagasse sourced from farmers are prepared for the production process. This involves cutting, washing, cleaning, drying and size sorting.
3. Material mixing: The sorted LDPE plastic is mixed with the prepared agricultural materials according to specific ratios for each formula developed by Rewastec.
4. Production of recycled composite plastic pellets: The mixed materials are fed into a twin-screw extruder to produce high-quality recycled composite plastic pellets. The production of the recycled composite plastic pellets is done by a partner company.
5. Chemical enhancement: During the production process, Rewastec utilises an optimised chemo-mechanical method to extract nanocellulose fibres from rice straw. This enhances the mechanical properties of the plastic pellets, such as tensile strength and impact resistance. The chemical enhancement process is carried out by Rewastec expert team at the outsourcing factory.

The addition of nano and micro-fibres from the rice straw and agricultural waste helps address issues of material strength and distribution within the composite, resulting in a superior end product. The resulting fibre-reinforced recycled plastic pellets can be used as raw material for a variety of applications including in furniture, home decoration, and industrial uses, particularly in the telecommunications sector.

Wisarat Chalee's academic research on developing polymer composites from recycled polyethylene

1 https://www.pcd.go.th/wp-content/uploads/2021/10/pcdnew-2021-10-19_08-59-54_995414.pdf

2 <https://www.iqair.com/us/newsroom/thailand-2021-burning-season>

80+ Plastic Recycling Formulas



PET RECYCLE

Tensile Strength : 57.02 Mpa
Elongation at break : 2.90 %
Young's modulus : 2.64 Gpa
Flexural strength : 87.93 Mpa
Flexural modulus : 8.55 Mpa
Haedness : -
Impact strength : 2.98



HDPE RECYCLE

Tensile Strength : 20.23 Mpa
Elongation at break : Not Break
Young's modulus : 1.09 Gpa
Flexural strength : 21.55 Mpa
Flexural modulus : 1.36 Mpa
Haedness : -
Impact strength : 18.90



LDPE RECYCLE

Tensile Strength : 15.14 Mpa
Elongation at break : 626.80 %
Young's modulus : 13.13 Gpa
Flexural strength : 11.65 Mpa
Flexural modulus : 294.44 Mpa
Haedness : 30.27
Impact strength : Not Break

(LDPE) and rice straw fibres has been the foundation for several innovations that extend from Rewastec's research and development efforts. These innovations have led to the establishment of 70 distinguishable pieces of Intellectual Property Rights (IPR) concerning the compounding methods using twin-screw extrusion to produce these pellets and filaments of different specification and quality of PET, HDPE and LDPE products. The combined IPRs protect against copying by competitors and justify further product development. They also highlight the company's commitment to the application of leading-edge materials technology to the recycling of plastic waste and production of high-quality recycled plastics.

Rewastec contributes to sustainable materials use by recycling a mixture of plastic and agricultural waste fibre into valuable composite recycled plastic. This is a promising innovation that can contribute to global environmental goals and the transition to a circular plastics economy.

Circular Economy impact

Rewastec Company Limited practices key strategies for circular economy, in particular circular use of materials (or resource circularity) and use of alternative renewable materials (or resource substitution).

From 2023 to June 2024, the company produced 3,500 kg of recycled plastic composite pellets. These used 3,000 kg of plastic waste, which was thus diverted from being landfilled.

Recycled plastic has lower embedded GHG emissions than virgin plastic. Using publicly available benchmarks, the company estimated it had

mitigated between 4.5 and 9 metric tonnes of CO₂ emissions during the same period. In addition to the recycling of 3,000 kg plastic waste, the compounding process incorporated 542 kg of agricultural waste, thus diverting it from open burning which would have contributed to air emissions, including PM2.5.

Recycling of plastic waste results in reduction of life-cycle energy use for recycled plastics, compared to that for virgin plastics. As per publicly available data³, recycling PET reduces life-cycle energy use by 78%, and recycling HDPE or PP reduces life-cycle energy use by more than 88%.

Business and market impact

Rewastec Company Limited has yet to achieve cost-recovery; however, it is within reach to be achieved in 2027. The projected revenue for 2024 amounts to 57 million Baht (approximately 1.45 million Euro). The company is firmly focused on achieving sales targets to OEM cable and wire manufacturers, given the advantages its recycled composite plastics have for this niche application. Rewastec, therefore, intends to scale-up its monthly production to 30 metric tonnes of compounded recycled pellets.

Rewastec positions its recycled plastic compounded materials as a sustainable alternative in industries that traditionally rely exclusively on virgin plastics. This contributes to environmental sustainability and taps into the growing market demand for greener products, particularly in niche markets requiring high-quality recycled plastic pellets and filaments, such as furniture, home decoration, and for industrial uses.

3 <https://www.plasticsnews.com/article/20190215/FYI/190219885/recycled-vs-virgin-resin-total-energy>

Stakeholders

Rewastec has engaged with various stakeholders to support its operations and expansion plans. These include:

Local Suppliers: The company provides additional income of 50,000 Baht (approximately 1,250 Euro) annually for 10 village suppliers in the farming areas around Suranaree University of Technology in Nakhon Ratchasima Province, Northeast Thailand. This partnership not only secures the necessary raw materials for production but also supports the local economy.

Financial Supporters: Rewastec received financial assistance from the technological and innovation fund for entrepreneurs provided by the National Innovation Agency. This support has been crucial for funding ongoing research, and developing and scaling up the production processes.

Corporate Customers: The company's corporate clients include major names such as HMC Polymers, Wastic Thailand, Asia Packaging Group Company, Plaplu and Lepolis. These relationships are key to Rewastec's business model, focusing on OEM business customers particularly in sectors such as telecommunications, which require high volumes and consistent quality of material supply.

These stakeholders play significant roles in various aspects of Rewastec business, from raw material supply and financial backing to becoming direct consumers of the recycled compounded pellets and filament. Engaging these groups effectively remains critical for the company's full scale-up and development.

Implementation

In Thailand, where waste segregation is limited, Rewastec faces challenges in securing a steady supply of quality plastic waste. The company is looking to collaborate with large agencies such as hospitals to improve consistency of waste supply by collecting non-infectious plastic waste that requires only standard cleaning, not sterilisation. The company still faces challenges in marketing, developing business models with partners, and estimating prices and costs due to limited business knowledge and experience. Overcoming these challenges is necessary to achieve feasibility and scalability of the business operations.

Rewastec outsources the production of plastic pellets and filaments to factories with existing production infrastructure and capacity. This has allowed the company to increase production to meet the growing demand for recycled plastic pellets,

especially when starting to supply larger volumes to OEMs. In addition, Rewastec could benefit from the expertise and technology of these collaborating factories, thus improving the quality and efficiency of the pellet production. The collaborations help Rewastec reduce costs and manage risks by reducing its own investment and capital requirements, and diversifying its supply chain.

Overall, Rewastec's implementation strategy focuses on collaboration, cost-effective scaling, and improving operational knowledge to overcome industry barriers and grow its market presence effectively.

Takeaways

Rewastec's business experiences illustrate the following:

- **Innovative use of waste:** Rewastec demonstrates the potential of transforming plastic and agricultural waste into premium quality recycled plastic composite pallets. This highlights the importance of upcycling, which adds value to waste materials by creating new, higher-quality materials.
- **Economic potential of recycling:** The case shows potential for economic viability of recycling and upcycling of plastic waste by creating premium quality recycled materials.
- **Community engagement:** Rewastec's collaboration with farmers and local communities to source raw materials demonstrates the positive social impact businesses can have by engaging with and supporting local stakeholders.





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Disclaimer

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