



Comparative Study of Natural Rubber Latex Foam Cushion Degradation for Sustainable Waste Management

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Abstract

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Natural rubber latex foam (NRLF) cushions have been developed as a sustainable alternative to plastic-based cushioning for fresh produce. To support circular economy strategies, this study investigates NRLF degradation under two post-consumer scenarios: (1) soil burial and (2) sunlight exposure. Results show that UV from sunlight significantly accelerates degradation—over 60% of mechanical strength is lost within 7 days, and 35% of foam cell walls collapse, reducing cushioning efficiency. In contrast, soil burial under moist conditions leads to gradual biodegradation within 24 weeks, even without UV exposure. These findings suggest that NRLF does not persist in the environment like plastic-based foams. To enhance sustainability, this study proposes a reuse strategy where NRLF cushions are collected and reused before final disposal. This approach could extend product life, reduce environmental burden, and align with circular economy goals. Understanding NRLF's degradation mechanisms under different disposal scenarios

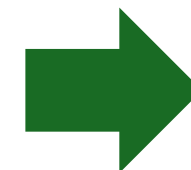
Why It Matters



1 in 3 fruits got damaged during transportation



EPE cushion is commonly used to protect fruits, but it creates environmental pollution

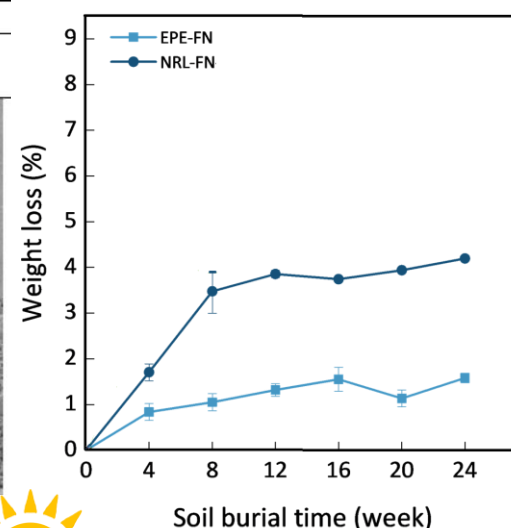


Innovative **Eco-friendly cushion** from NRLF

Degradability Test of NRLF Cushion

Soil Burial Test (24 weeks)

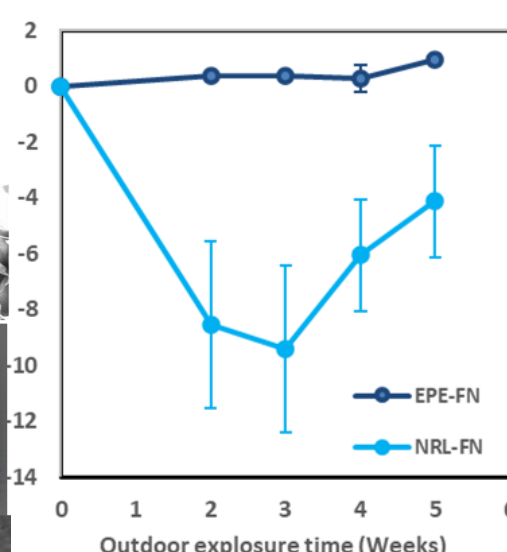
Cushion Foams	Foams Appearance		Foams Micrograph	
	Before Soil Burial	After Soil Burial	Before Soil Burial	After Soil Burial
EPE-FN				
NRLF-FN				



- Gradual degradation was observed in both EPE-FN and NRLF-FN
- NRLF-FN degrades to a greater degree in 24 weeks of soil burial test, with maximum weight loss of ~4%
- NRLF in storage condition (room temperature, in the absence of direct sunlight) **lasts longer than 2 years** without losing cushioning property. It is expected to be able to **reuse over 20 times**

Sunlight Exposure Test (5 weeks)

	Week 0	Week 2	Week 3	Week 4	Week 5
EPE-FN					
NRLF-FN					



- **Rapid degradation** was observed in **NRLF-FN** under direct sunlight, but not significant in EPE
- NRLF-FN appearance indicated a greater degree of degradation since **week 2**, and fully crumbled by week 5
- The apparent negative weight loss may result from microbial colonization or moisture retention. Further analysis is underway

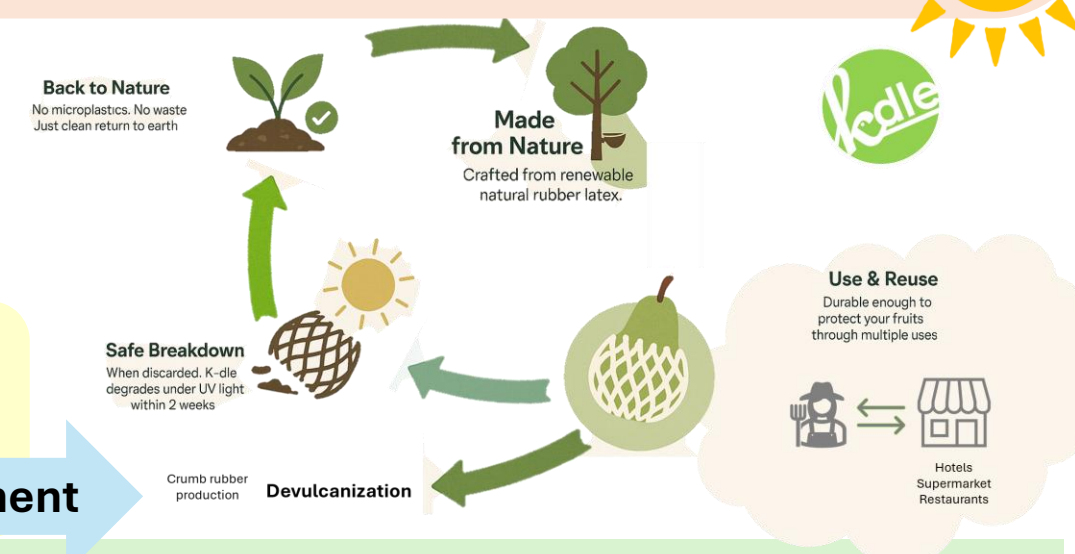
Conclusion

UV light from direct sunlight exposure is effective for degradation of NRLF and could be used as a tool for end-of-life management of the novel cushion of NRLF, after reuse over 20 times

The End-of-life management

References

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NRLF cushion offers a practical solution to single-use plastic foam. Built for reuse—engineered for sustainable breakdown.