Recycled Wool-Polymer Composites

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At-A-Glance Introduction

The project aims to engineer a composite material using recycled, unbundled waste wool and plastic. A composite combines two different materials that improve the end mechanical properties. Recycled plastic and wool are two major sources of material waste today. Wool composites have many potential applications, including medicine and construction. This project's target application is medicinal and protective footwear.

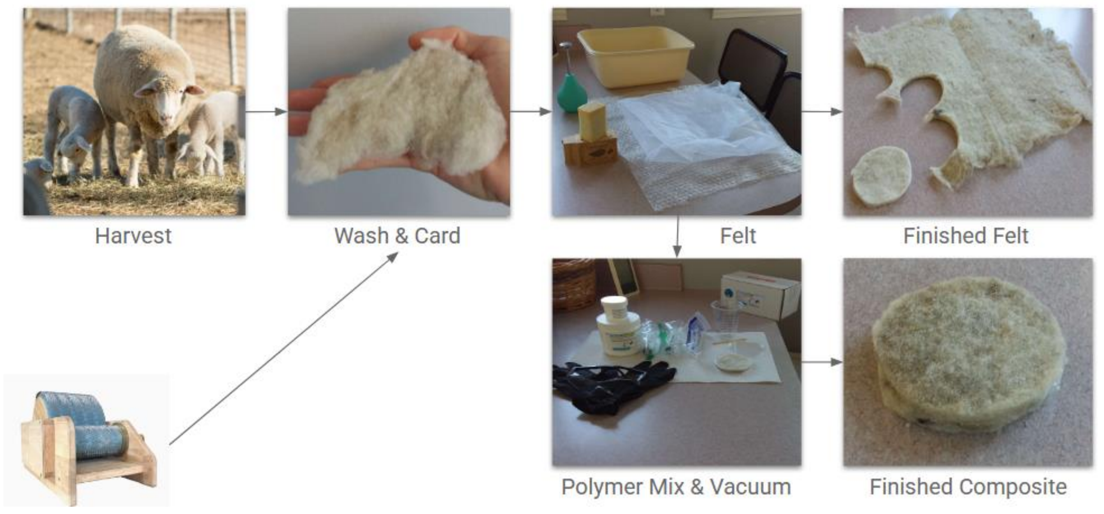
Objective

- Create composite materials by reinforcing recycled wool with polymer, obtain valuable data on characteristics, and determine overall viability for our target market, footwear.
- Inform engineering projects and give a proof of concept product

Via Magi Kern, 2021

Design, Materials, Methods

- Using 80mm diameter, 13mm thick petri dish molds for 'puck' samples
- Dorset Wool, via CPP Sheep Unit
- Washed, Carded, Olive oil soap and bubble wrap hand-felt

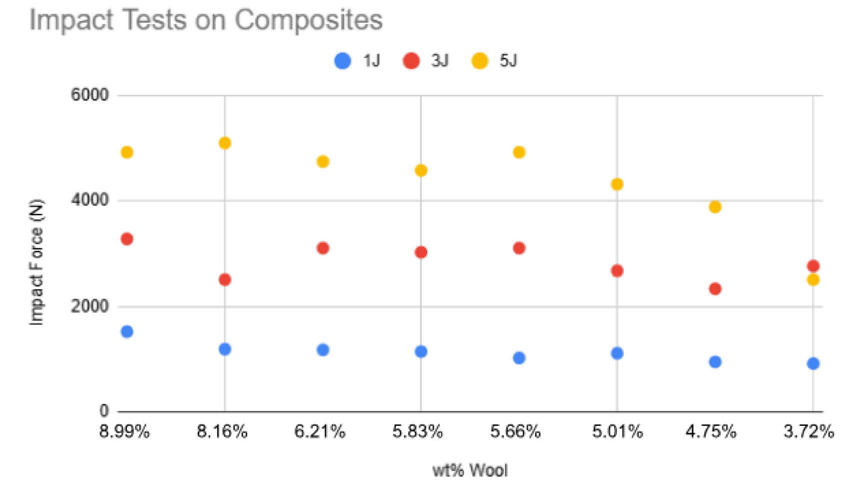


- Using PDMS (sylcap 284)
- 10:1 mixing ratio, introduced via syringe with a layering technique

- Vacuum Chamber used for even mixing and bubble elimination
- 3-9 wt% range

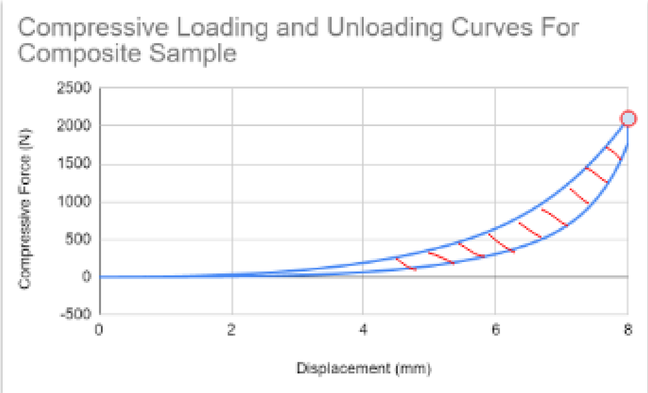
Results

Impact Tests on Different wt% Composite Samples
- 1J, 3J, and 5J
- Lower wt% fiber composites showed some improvement at higher impacts.
- Hard to find observable trends at lower impacts.
- High weight cost associated with lower wt% composites.

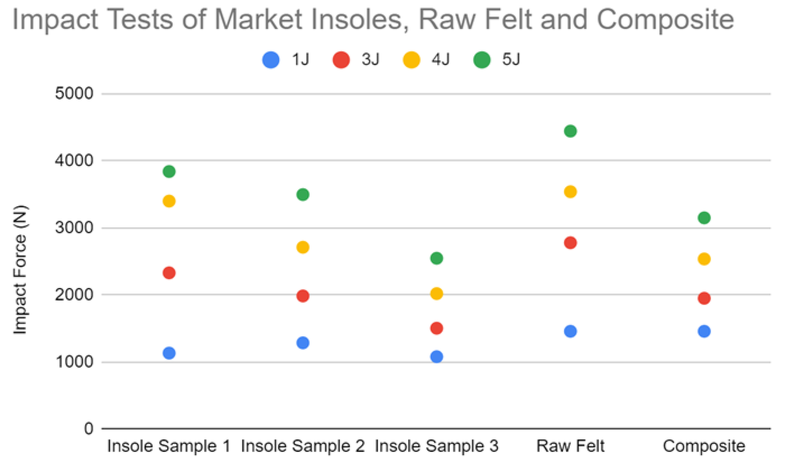


Compression Tests:
- 30% Compression, loading and unloading
- Target data: Peak Force (N), Energy Absorbed (J)
- Obtained Compressive Strength, Able to compare density with performance
- Energy Absorption from longer loading duration

Specimens	Peak Force (N)	Energy Absorbed (J)	Density (g/cm^3)
Insole Sample 1	118	0.270	0.037
Insole Sample 2	718	1.600	0.0652
Insole Sample 3	1217	3.300	0.076
Raw Felt	18	0.053	0.0305
Composite	2097	4.290	0.334



Impact Tests on High wt% Wool and Wool Insole Samples
- 1J, 3J, 4J, 5J
- The composite increased the performance of the base felt by up to 30%

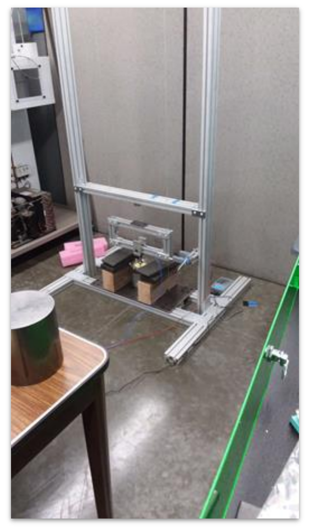


Summary & Conclusions

- This composite material and methods used to produce it are certainly viable for applications in footwear.
- Given the low density of the base felt, the added performance from the polymer is promising.
- Larger wt% fiber samples were way more comparable to other insoles.
- There is a limit to how little polymer can be introduced by the project methods.

Future Work

- Density balancing will be crucial for success
- Manufacturing process must be made more consistent, with better felting and higher/consistent density felts
- Explore other composite manufacturing techniques
- PDMS has a limited range of recyclability, and is hard to recycle.
- Other polymers of interest: PP, PET



Acknowledgements & References

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