

VersrTile

Vinyl-Coated Fabric to Roof Tile
Recycling Project 2018



Vinyl Council Australia



PVC STEWARDSHIP



METROPOLITAN
WASTE AND
RESOURCE RECOVERY
GROUP



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Executive Summary

The Vinyl Council of Australia completed a project part-funded with a \$20,000 grant from the Victorian state's Metropolitan Waste and Resource Recovery Group (MWRRG) to investigate the feasibility of recycling vinyl-coated fabrics into roof tiles. The Council is committed to encouraging product stewardship in the vinyl value chain in Australia and to advance the circularity of vinyl, or PVC, materials.

A key challenge in Australia is finding and developing viable end markets for plastics that customarily go to landfill. Until recently, no solutions had been identified for vinyl-coated polyester fabric used for applications such as advertising banners, truck tarpaulins and grain covers.

This project enabled an expert multidisciplinary team led by the Vinyl Council to design and test reprocessing techniques and form prototype roof tiles made with waste vinyl-coated fabric. The project outcomes included testing the manufactured sample tiles, which found the tiles could resist weathering as required under applicable standards; however, further development is required on the tile prototypes to meet mechanical strength tests required for roof tiles.

A preliminary business case has been developed to understand the financial and production factors that will be required to manufacture these roof tiles economically and to assess their commercial feasibility.

The significance of this project is that it identifies a potential reuse of a composite material into a durable, high volume product without the need to separate the polyester fibre from the vinyl.

Project Team	Expertise
Welvic Australia	Reprocessing and compounding
Monash University	Industrial design, prototype and sample production
Boral Roofing and Masonry	Roof tile market manufacturing
Vinyl Council of Australia	Project coordination, supply chain expertise and networks

How this project came about

In 2013-14, the Vinyl Council commenced the first in a series of projects looking at end markets and mechanical processing options for banner waste as part of its commitment to create a viable vinyl recycling practice in Australia. A second, follow-on research project in 2015-17, part-funded by the NSW Environment Trust, identified potential end product concepts that might be a suitable use for the recycle. These included pallet slider sheets, highway sound attenuation barriers, woven bags, and roof tiles. The priority was to find high-volume, value-added

products that could be derived from low cost reprocessing techniques.

This 2018 project was focused on the roof tile concept and a leading building product manufacturer joined the team to investigate the concept and commercial viability. Currently roofing tiles in Australia use virgin material, predominantly cement or furnace-fired clay.

The purpose of this project was to finesse the product concept design arising from the previous design research, explore reprocessing methods and make and test prototype roof tiles using end-of-first-life vinyl banner material. A preliminary business case for the potential roof tile product was also to be completed.

Pursuing innovation

Currently an estimated 5,000 tonnes of vinyl-coated polyester fabric such as advertising banners, truck tarpaulins and grain covers, go to landfill each year in Australia. In addition, this durable material is used for construction site mesh, shade cloth, tent marquees, jumping castles, etc.



Collected waste billboards

There has been little of this material reprocessed on a continuous basis elsewhere in the world. A chemical reprocessing plant for the material recently closed down in Europe as it was no longer economic.

Approach

The project team combined design, manufacturing, tool-making and reprocessing expertise. Monash University engaged an industrial design graduate to support the team with roof tile design.

Three variants of the prototype were designed and several sample tiles of each design manufactured.

Boral built a test rig and the tiles were subjected to specific weather and mechanical tests to meet Australian Design Standards.

The business case collated information on the potential market, sale price point, production costs and rates, and potential sources of material.

The team met regularly to share and discuss results, report issues and agree forward steps. Reports were submitted at project milestones to the MWRRG.

Project outcomes and findings

(1) Tile design

Building from the 2015-17 research, the project team developed and refined three prototype designs and designed the tooling to manufacture several samples of each design. The design of the prototypes led to a surprisingly good quality finish for the tiles.

(2) Reprocessing

This project confirmed that the reprocessed material can be effectively molded into a complex form with appropriate finishes. Tile detail was improved through the molding process by improving the design of the soft tools. The team trialed different reprocessing methods, from shredding and granulation to cutting strips of fabric for extrusion, producing different fibre lengths. The greatest influence these had was found to be the speed of manufacturing, and shredding and extruding into the molds was found to be the fastest process.



(3) Weathering & strength

The tiles were subjected to specific weather and mechanical tests to meet relevant tile standards.

The prototypes were tested to AS4606.9 Dynamic Weathering Test with the tile design and composition performing well, even at a very low roof gradient of 9°.

However, the mechanical Transverse Break Test indicated that the composition of vinyl and polyester was too flexible at temperatures at or above 50°C for roof tiles to hold their shape under load with a traditional roof batten layout. Although flexibility means they are very difficult to break, the mechanical strength of the tiles needs further work such as additional strengthening in structure and/or material composition. To meet the product specifications

for modulus (bending), it is likely the formulation of the material may need to be adjusted.

(4) Business case

The business case indicated that the sources of waste identified would need to be significant in volume to provide sufficient material to meet full-scale production and additional sources of vinyl-coated polyester fabrics beyond banner and billboard skins would be required.

The business case indicated that premium roof tiles would require a high rate of production to be economically viable and would require in excess of 5,000 tonnes of feed material per annum, and possibly as much as is sold in the Australian market, estimated to be 22,000-30,000 tonnes annually.

It was beyond the scope of this project to research the total quantity of all vinyl-coated fabric waste in the Australian market that may be available for recovery and to identify where might be the optimum points for recovery in the supply chain.

The project would need strong commitment from the entire value chain for it to be financially viable, with mechanisms and incentives to encourage diversion of the material from landfill. Costs of transport and reprocessing need to be addressed.



Roof Tile TBS 001 Hydraulic Pressure Gauge at approx 1.8MPa (Max deflection)



Roof Tile TBS 002 Tile at maximum deflection of 20mm



Roof Tile TBS 003 at max deflection 20mm plus ruler



Roof Tile TBS 004 Post Test

Visuals from mechanical test results showing deflection and no breakage at max pressure of 1.8MPa

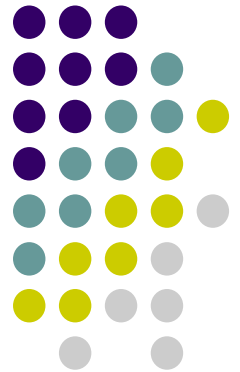
Next steps

This project is a mid-term step. It is anticipated that it will take another 1-2 years with further investment to scale up production and coordinate waste material feed stocks.

Further work and investment is required so as:

- To improve tile design to address flex and meet higher volume production requirements
- To improve the reprocessing and production process to achieve higher volume, faster production and lower cost per unit
- To design and develop in collaboration with the vinyl-coated fabrics value chain an industry-supported waste collection scheme, possibly in the form of a new stewardship scheme.

For further information on this project, please contact the Vinyl Council at info@vinyl.org.au.



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This project has been supported by a grant from the Metropolitan Waste and Resource Recovery Group.