

Technology Brief

INDUSTRIAL RESILIENT FLOOR TILES FROM POST-CONSUMER CARPET WASTE

Introduction

RepTile™, manufactured by SelecTech Inc., is a resilient floor tile made from a blend of PVC and mixed post-consumer carpet waste. During early production of this product, problems arose with respect to processing efficiency, and distortion, or “peaking”, of the tiles in the field. This project was designed (1) to modify the existing production process in order to improve efficiency and reduce cost; and (2) to determine the cause of peaking distortion, and to modify the process and/or the material formulation to overcome the problem.

Background

The many different types of resins and materials used in carpeting and carpet backing make this recovered material stream very non-homogenous, and thus difficult to recycle without costly separation. One type of carpet in particular, vinyl-backed carpet tile, is a problem stream for recycling. Vinyl-backed carpet tile consists of a vinyl backing, a fiberglass reinforcing sheet, and nylon or polyester face fiber. These tiles are too costly to separate for recycling, and when ground for use as a typical re-grind feedstock, the fibers clog conventional plastics manufacturing machinery and can cause equipment damage.

SelecTech Inc. has developed a patent-pending method for producing an industrial-grade resilient floor tile, by re-using mixed carpet waste, including vinyl-backed carpet, in a process that retains the fiberglass, nylon, and polyester intact as fibers to reinforce the finished product. The resilient floor tile, known as RepTile™, is manufactured from a commingled mixture of shredded vinyl-backed carpet tiles, post-industrial PVC, and proprietary additives. The blend combines the flexibility of PVC with the strength of glass, nylon, and polyester fibers.

The ability to compete in the resilient flooring market is based on quality and price. Testing has shown the RepTile to be comparable or superior in quality to competing resilient floor tiles made with virgin materials. At present, the critical stage of development in the product depends upon increasing efficiency and reducing production costs, while maximizing recycled content.

Key Words

Materials: Vinyl backed carpet tile, carpet, carpet backing, postindustrial PVC.

Technologies: Shredding, grinding, granulating, blending, extruding, injection molding.

Applications: Resilient floor tiles, resilient industrial flooring.

Market Goals: Develop processing technique to create resilient tiles that are competitive in price and quality with virgin-made tiles.

Abstract: Evaluation and field testing of resilient floor tiles, including development of homogenizing system for feeding and blending recycled carpet feedstock, and evaluation of injection molding process modifications for tile making.

System Design

Phase 1 of this project resulted in the design and installation of a customized extruder system that successfully combined three existing process steps (Molding Into Prep Tile, Granulating Prep Tile, and Dry Blending) into one revised process step (Extrusion into Nuggets). The nuggets are then used as a pellet feedstock for the tile injection molding process.

Product Testing

Phase 2 product testing was divided into four parts.

Part 1: Effect of recycled carpet concentration on the length and weight of the tile: Increasing recycled carpet content led to an increase in both the length and weight of the tiles. As carpet content increased from 10% to 40%, the tile length increased approximately 0.07 to 0.1 inches, and the weight increased approximately 0.1 to 0.3 pounds. Variations in the sizes and weights (as measured by standard deviation), from tile to tile, also increased. This indicates that the higher carpet content contributes to reduced homogeneity of the final product.

Part 2: Repeatability of the injection molding process: Results indicated that the revised processing and production

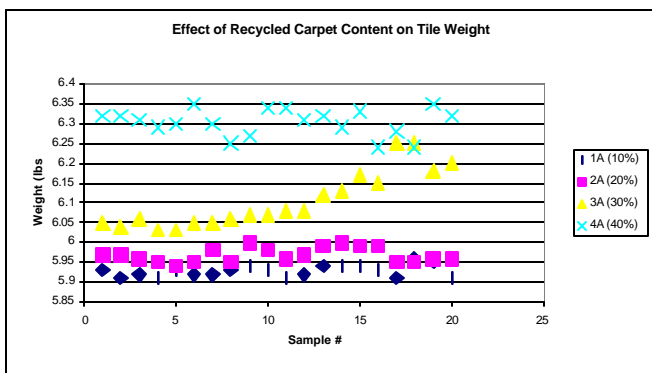
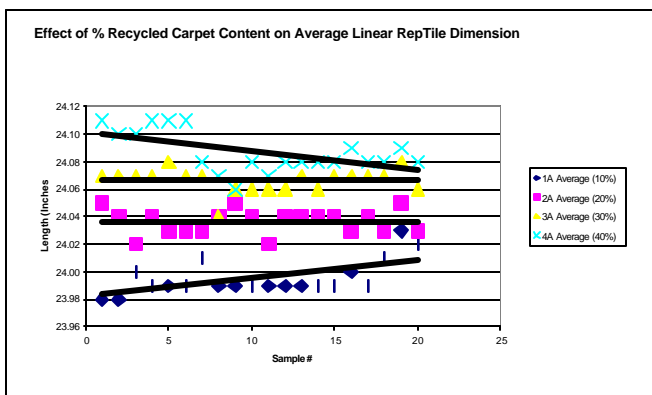


system could repeatably produce injection-molded tiles that show no evidence of peaking at recycled carpet concentrations as high as 20%.

Part 3: Effect of weathering on length, weight, and shape of the tile: Weathering observations on a 30% recycled carpet concentration batch indicated a trend for the length and weight of the tiles to increase slightly, however, the data was insufficient to draw conclusions with respect to the potential relationship of the increases with respect to peaking.

Part 4: Effect of blending efficiency on tile peaking: In an observation test of the relationship between peaking, and blending efficiency, it was noted that tiles made with 40% post-consumer carpet content did not exhibit peaking in response to weathering if the material passed through the blending/extrusion process more than once. Note that all tiles made at 40% content (with single-pass blending/extrusion) had demonstrated peaking in previous tests. This indicates that it is possible to maintain product quality at recycled content concentrations above 20% if the grinding/blending process can be sufficiently improved.

Representative plots of the relationship between recycled carpet concentration and tile length and weight are shown below.



Conclusions

This project resulted in the design and implementation of a system that is capable of economically producing consistent field-quality tiles using up to 20% post-consumer vinyl-backed carpet waste.

The concentration of post-consumer carpet content is currently limited by the level of mixing and homogeneity that is achieved by the system. If this can be improved, then the content of post-consumer carpet could be increased to both lower costs of the product and, potentially, improve performance. The following conclusions were also noted:

- The occurrence of distortion or “peaking” in field applications of finished tiles is directly related to the degree of blending, or homogeneity, of the recycled feedstock. The higher the concentration, the more likely the presence of agglomerates that will cause the tiles to distort due to temperature changes.
- Increasing the recycled carpet concentration leads to a corresponding increase in the weight of the finished tile.
- Increasing the carpet content, without thorough blending, reduces the process ability of the material. When carpet content is increased beyond 30% using standard in-process blending, the material does not consistently fill the mold resulting in rejects.
- The injection molding process for the tiles is repeatable within typical manufacturing limits. Peaking was not caused by size variations inherent in the molding process.
- The peaking is related to variations in thermal expansion of the feedstock materials. Peaking is exacerbated when insufficient blending results in the presence of agglomerates.
- Increased compounding efficiency increases the homogeneity of the final product and allows for higher post-consumer carpet content without end-product distortion.

Acknowledgements

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For More Information

For a copy of the report, *Industrial Resilient Floor Tiles From Post-Consumer Carpet Waste (No. IBP-00-1)*, or for more information, contact the CWC at (206) 443-7703, email info@cw.org, or visit the CWC Internet Website at www.cw.org.

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