Recycled Plastics as Green Building Materials

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Thermal Resistance Measurement System (TRMS 9000)
About the TRMS

- Funded by BEST seed grant
- Built by Cohesive Solutions.
- Measurement of R-Value and Thermal Conductivity with a standard deviation < 0.1%.
- Sample size can range from 3” diameter discs to 12”x 12” panels with a max. height of 8”. 
Front Readout

- Hot Plate Temp. Control
- Hot Plate Flux Reader
- Cold Plate Temp. Control
- Cold Plate Flux Reader
- Air Spring Pressure Gauge
- Air Spring Pressure Adjustment Knob
- Cold Plate Air-Flow Rotometer
- Hot Plate Air-Flow Rotometer
- Hot Plate Controller Stand-by Switch
- Heater Power Level Switch
- Cold Plate Controller Stand-by Switch
- Cold Power Level Switch
Computer Readout
Calculating the R-Value

\[ R = \frac{R_{\text{Hot}} + R_{\text{Cold}}}{2} \]

\[ R_{\text{Hot}} = \frac{B[(T_{\text{Hot}} - T_{\text{Cold}})/1.8]}{C_{\text{Hot}}X_{\text{Hot}}} \]

\[ R_{\text{Cold}} = \frac{B[(T_{\text{Hot}} - T_{\text{Cold}})/1.8]}{C_{\text{Cold}}X_{\text{Cold}}} \]
R-Value Equation Explained

- \( X = \text{Thermal Flux} \)
  - Readout from the TRMS in mV.
- \( C_X = \text{Calibration Constant} \)
  - Derived from an NIST standard sample.
  - Converts from mV to W/m\(^2\).
- \( B = \text{Unit Conversion} \)
  - Converts from SI Units (m\(^2\)K/W) to the more common English Units (ft\(^2\)h\(^0\)F/BTU).
Recycled Expanded Polystyrene (EPS) Panels

• **Objective**
  
  • To Evaluate the Thermal Properties of recycled Expanded Polystyrene (EPS).
  
  • Compare the Results to standard building insulation materials (e.g., *Dow Pink Tuff EPS*).
The Problem

• EPS is currently not accepted for recycling by most recycling programs due to it’s extremely low mass/volume ratio.

• Typically EPS is sent directly to landfills or stored in large warehouses.

• EPS occupies valuable “space” in landfills.
Property Analysis

• Panel Sample Variables*
  • Compression ratio
  • Density (final panel)
  • Adhesive content
  • Fire retardant (or not)
  • Tyvek covering (or not)

* Fabricated by the OSU Wood Science & Engineering Department
Results

Compression vs. R-value/inch

R-value/inch

Trial

3"/1.5"
5"/1.5"
7.5"/1.5"
Conclusions

• R-value/inch increases with increasing Compression Ratio

• Recycled EPS panels have similar R-values to the standard Dow Pink Tuff EPS currently used in the market (R/in. = 4.6)

• In the future, EPS could be locally recycled into panels to replace conventional building insulation for green building applications.
Yoga Mats
Introduction

• *Recycle Your Mat* (Eugene, OR) provided the yoga mats that were tested for insulation.
• *Recycle Your Mat* is studying other ways to recycle yoga mats (shoes, purses, etc.)

Objective

• Test various yoga mats to find their *R-value*.
• Determine if composition affects *R-value*.
• Determine which yoga mats are crosslinked (therefore cannot be melted and processed)
R-Value/inch for Yoga Mats

Sample

R-Value per inch

- Straw
- Soy Foam
- Blue Jeans
- Pink Foam
- Sample 34
- Sample 33
- Sample 32
- Sample 31
- Sample 30
- Sample 29
- Sample 28
- Sample 27
- Sample 26
- Sample 25
- Sample 24
- Sample 23
- Sample 22
- Sample 21
- Sample 20
- Sample 19
- Sample 18
- Sample 17
- Sample 16
- Sample 15
- Sample 14
- Sample 13
- Sample 12
- Sample 11
- Sample 10
- Sample 9
- Sample 8
- Sample 7
- Sample 6
- Sample 5
- Sample 4
- Sample 3
- Sample 2
- Sample 1
Conclusion

• Some yoga mats have R-values comparable to other “green” insulation materials (soy foam, cotton jeans, etc.), but are still 20% lower than traditional foam insulation.
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