Research Summary
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Dimensional Stability of Rigid Board Insulation Products

Building enclosure investigations and renewals often reveal irreversible dimensional changes in rigid foam board insulation products including XPS, EPS and Polyisocyanurate. If it has been speculated that these dimensional changes are a result of aging, they are also a result of thermal expansion and contraction due to the high in-service temperatures which can often be experienced within wall and in particular, conventional roof assemblies.

A research study was undertaken by ROCKWOOL and RDH to investigate and compare the dimensional stability of 10 insulation products collected from 7 manufacturers when exposed to a range of temperatures from -15°C to 90°C.

Polyisocyanurate	XPS	EPS	Stone wool
CARLISLE SecurShield™	DOW Corning Styrofoam™	Plasti•Fab® DuroFoam®	ROCKWOOL TOPROCK® DD
ATLAS® ACFOAM®-II	OWENS CORNING FOAMULAR® C-200	Plasti•Fab® PlastiSpan®	ROCKWOOL TOPROCK® DD PLUS
IKO IKOTherm™			
IKO EnerFoil™			

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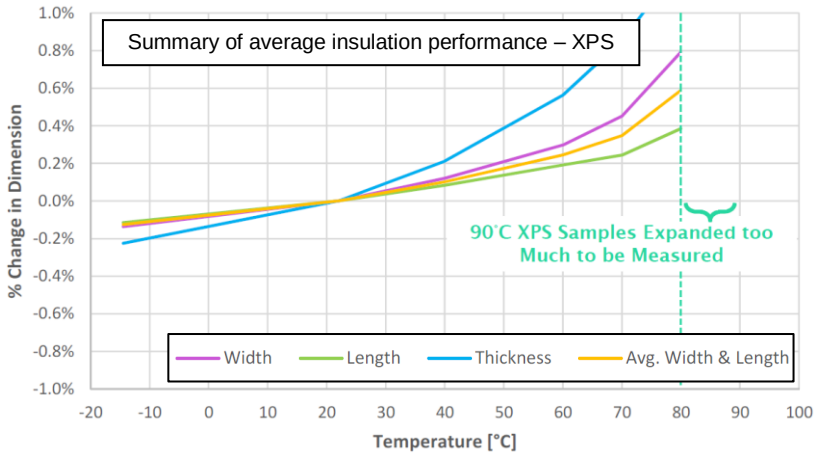
Extruded Polystyrene (XPS)

At lower temperatures (-15°C to 40°C), XPS appeared elastic and generally returned to its initial dimensions at 22°C.

As the temperature was increased, 60°C and higher, permanent, inelastic deformation, was observed.

XPS significantly expands and warps at high temperatures.

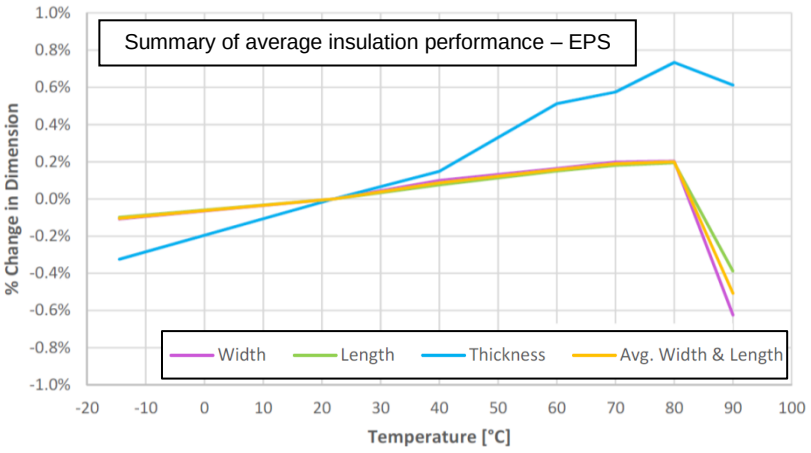


Expanded Polystyrene (EPS)

EPS was observed to expand as temperature increased and then return to its initial dimensions when let cool.

Above 80°C, significant inelastically contraction was observed.

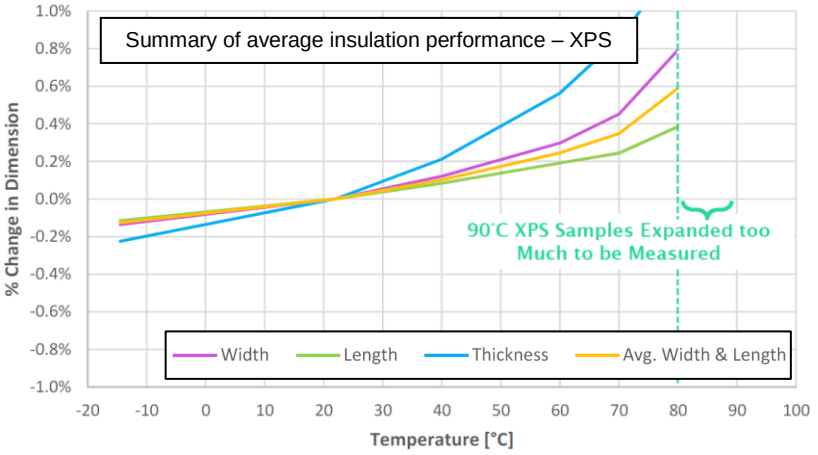
EPS expands as temperature increases, but at a certain point it will shrink significantly.



Polyisocyanurate

When heated between 40°C and 70°C, polyisocyanurate insulation permanently contracted once settled to room temperature when compared to the initial measurements.

Temperatures above 70°C appear to cause an expansion in the room temperature dimensions. The cause of this phenomenon is still under review but may be related to structural cell changes from off gassing at increased temperatures.



Above 80°C, the insulation was also found to increase in thickness. **Polyisocyanurate insulation showed both permanent thermal expansion and contraction as the temperature increased.**

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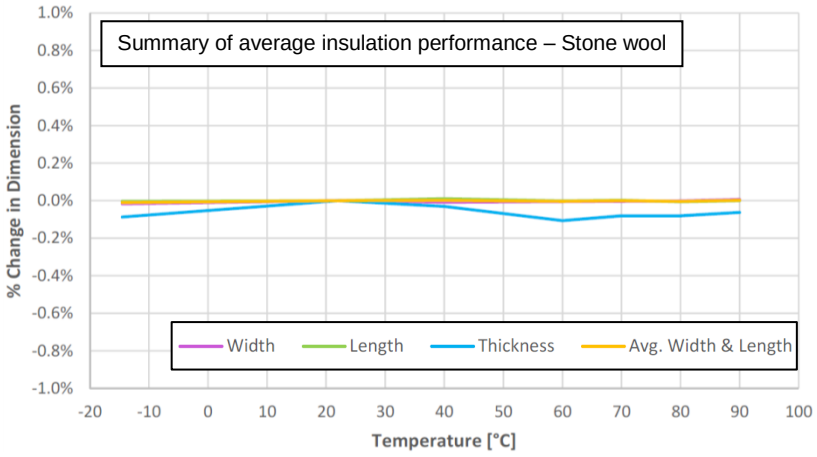
Stone Wool

The stone wool insulation products maintained constant dimensions throughout the testing procedure.

There were no significant indications that thermally induced expansion or contraction took place across the samples tested.

Stone wool is the most temperature stable of the four different insulation types.



In conclusion, the results of this research demonstrate that rigid foam insulation products (EPS, XPS and polyisocyanurate) are dimensionally affected with changes in temperature.

Elastic expansion and contraction was typically observed initially in the foam insulation products, but at elevated temperatures (varying between each foam insulation type) permanent inelastic deformation was observed, and in some cases significant warping of the products.

The dimensional changes observed correspond with gaps of up to ¼" of expansion or contraction in a 4' long insulation board. This is consistent with the expansions and contraction previously observed in field investigations.

% change in dimension 12" × 12" sample	Approximate expansion / contraction equivalent on a 4' insulation board	Approximate expansion / contraction equivalent on a 8' insulation board
0.2	3/32"	3/16"
0.4	3/16"	3/8"
0.5	1/4"	1/2"
0.6	9/32"	9/16"
0.8	3/8"	12/16"
1.0	1/2"	1"

Only stone wool insulation was measured to have negligible expansion and contraction when compared to the other tested insulation types.

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