

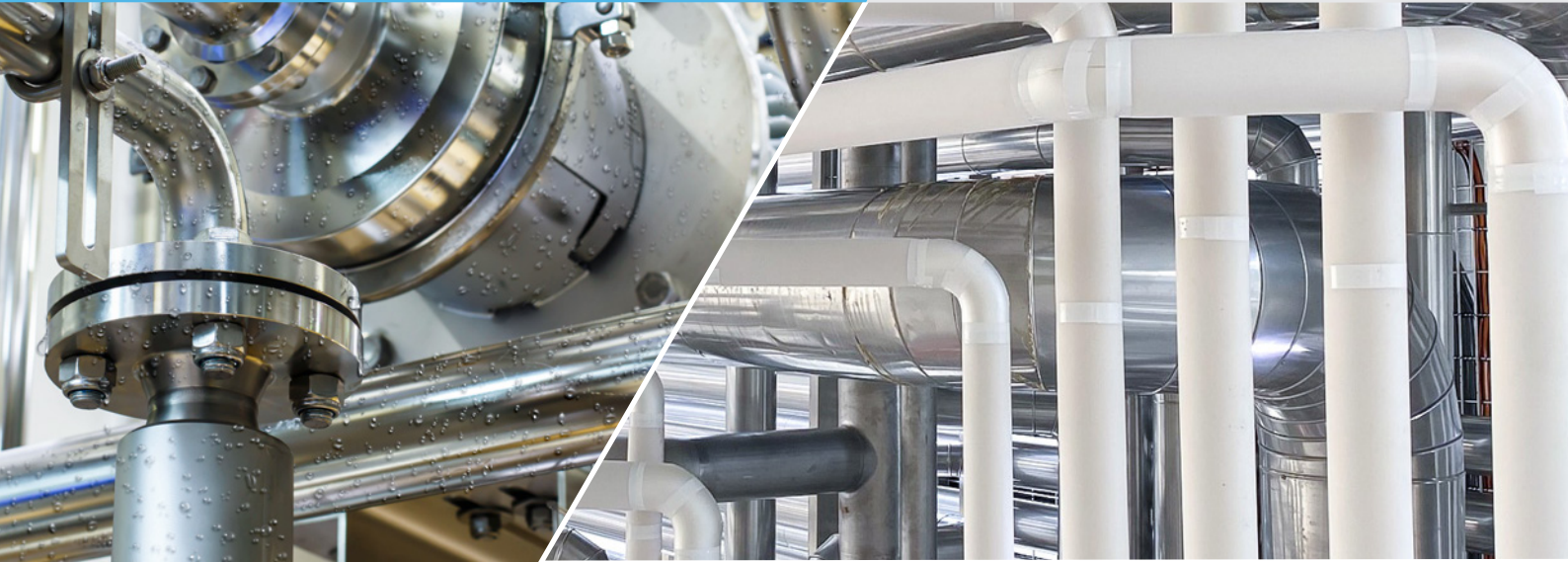
T-FIT[®] Clean

Insulation failure linked to moisture absorption

T-FIT[®]

INSULATION

Fit to perform. Fit to last



The importance of preventing moisture absorption into thermal insulation materials is often misunderstood. Having a thermal conductivity some 25 times greater than air, even small amounts of vapor ingress into open cell insulation can render such products pointless.

Introduction

This fact was discussed some time ago in an ASHRAE journal by Ludwig Adams, who hypothesized that just 4% moisture content by volume could increase thermal conductivity by 70%, a theoretical deterioration in insulation performance which would completely undermine product performance of open cell insulation.

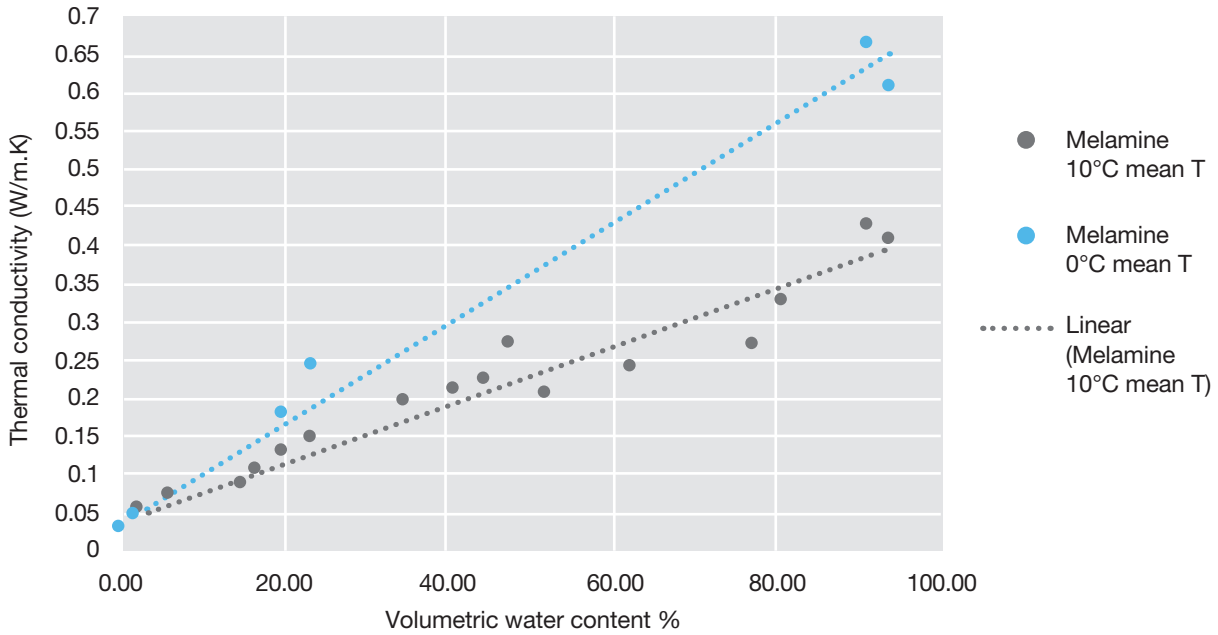
T-FIT, well-known producers of closed cell PVDF based insulation products undertook to test how moisture absorption impacts thermal conductivity in open cell insulation materials. Taking readily available open cell melamine insulation and closed cell T-FIT Clean insulation, (based on Zotefoams Zotek F42HTLS) samples were conditioned to achieve different water contents.

Samples of melamine foam were placed in a humidity chamber to accurately determine water content at various levels of absorption. Once the target level of moisture was achieved, the wet sample was placed in a sealed plastic bag to maintain moisture content throughout thermal conductivity measurement.



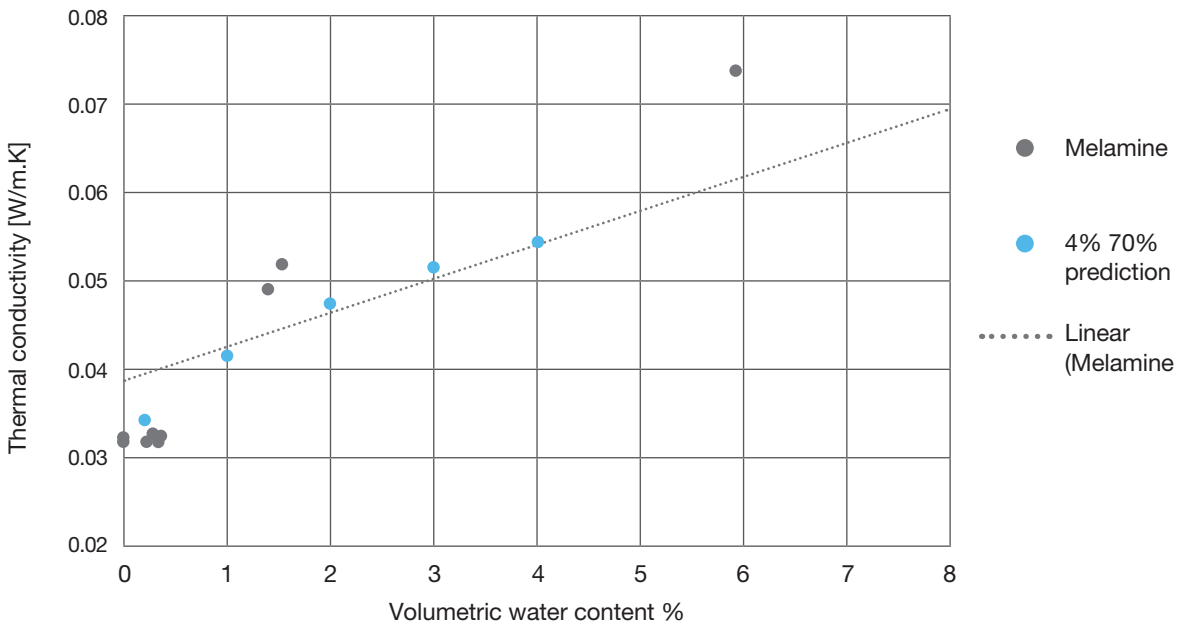
Samples of T-FIT Clean were fully immersed in a water bath. Even after 155 hours soaking in water, thermal conductivity remained 0.033 W/m.K at 10°C mean temperature to two significant figures.

The following graphs show the test results from moisture impacted melamine foam:



Graph showing thermal conductivity of melamine foam at 10°C and 0°C mean temperature.

The graph clearly shows the relationship between water content/absorption and increase in thermal conductivity.



Graph showing thermal conductivity of melamine foam, up to 20% moisture by volume, compared to the ASHRAE Journal prediction.

The graph above shows how accurate was the original calculation described by Ludwig Adams some time ago in an ASHRAE Journal. With just 4% absorption of water, the thermal conductivity increased by 70%.

Conditioning of ZOTEK F42HTLS samples	Volumetric moisture content (%)	Thermal Conductivity at 10°C (W/m.K)
Dry	0	0.033
95% humidity for 168 h	0	0.033
750h ageing plus 95% humidity for 120 h	0	0.033
1 h water bath	0.5	0.033
16 h water bath	0.6	0.033
25 h water bath	0.6	0.033
155 h water bath	0.9	0.033

Thermal conductivities measured for ZOTEK® F42HTLS foam at a mean temperature of 10°C. It was difficult to absorb moisture into the samples, and the additional weight of water after soaking in water bath is likely to have been mostly contained on the surface of the samples.

The above data table shows just how resilient modern PVDF closed cell insulation is to moisture absorption, even when samples are submerged in a water bath for 155 hours thermal conductivity remained at 0.033 W/m.K at 10°C mean temperature to two significant figures.

The test results show the importance of cladding system design for open cell insulation materials and consequences of poor installation. Longevity of traditional open cell insulation is dependent on continuity of often thin flimsy, poorly fitted outer coverings that easily allow moisture to penetrate the insulation, with resulting huge loss in performance as this testing demonstrates.

Physical test results also demonstrate outstanding resilience to all attempts to drive moisture/water into the structure of a modern closed cell, PVDF insulation, in this case T-FIT Clean produced from Zotefoams Zotek F42HTLS. Such products do not require the addition of any outer cladding to prevent moisture/water penetration, making installation an easy process to understand and complete.

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