KNOW-HOW

MOISTURE TEST

Condensation control is a key feature that all insulation materials must perform in cold applications. This document shows the performance of three different materials in a moisture resistance test conducted by the Fraunhofer Institute. At Armacell, we help you make better and informed choices about the right insulation solution for your projects. **Engineering foam technologies since 1954.**

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Testing moisture resistance performance

Introduction

The right insulation, correctly installed helps prevent condensation. This is important because when condensation forms on the insulation surface or seeps through to the equipment beneath, the system performance is challenged as a result of higher energy losses. Corrosion can occur under the insulation and mould can also multiply. These can result in significant maintenance and repair costs as well as operational downtime.

A study was conducted by the renowned Fraunhofer Institute, Europe's largest application-oriented research organisation, to have a better understanding about the impact of moisture on three well-known insulation materials:

- Flexible elastomeric foam (FEF)
- Mineral wool with aluminium foil covering
- Polyurethane (PUR) with polyvinyl chloride (PVC) foil covering

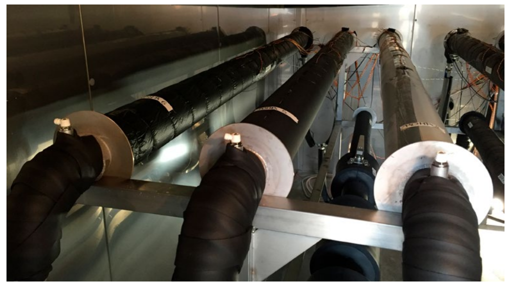
At the end of the test, the amount of moisture the insulation materials would absorb over 33 days was measured. The results were then extrapolated for an operating period of ten years for evaluation.

Experimental procedure

Three test pipes were insulated and set to operate at a line temperature of 20°C in a climate chamber. This is to ensure that the ambient temperature of 35°C and relative humidity of 55% was consistent throughout the test period of 33 days.

For added realism, two small holes of 5mm in diameter were drilled, 5mm deep into the surface, on opposite sides of the pipe section. This is to simulate damage to the insulation system, which is often the rule rather than an exception in practice.

Figure 1. Test specimens in the climate chamber.



Results

At the end of 33 days, the water vapour diffusion resistance factor (μ-value) of the different insulation materials was measured. The μ-value was similar for FEF in both the damaged and undamaged pipes at about 10,000. However, the μ-value declined significantly for the other two materials as shown in Table 1.

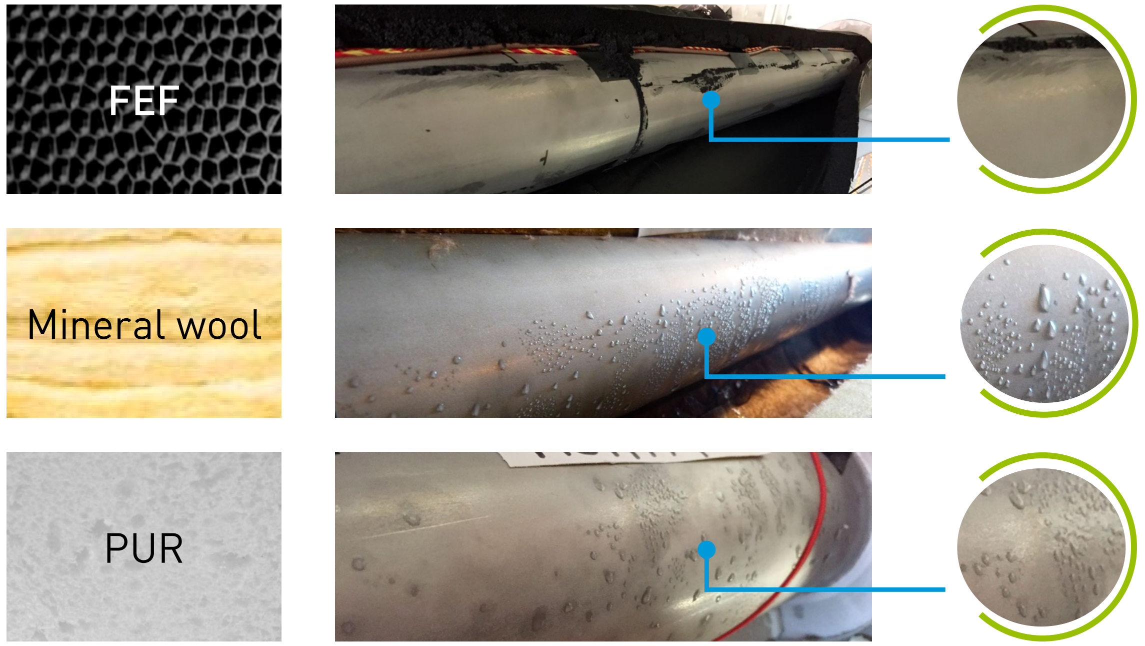
Table 1. μ-value test results

Material tested	Undamaged pipe	Damaged pipe
Mineral wool with aluminium covering	7,053	467
PUR with PVC covering	2,163	672

Further assessment

Despite the moderate test conditions and short time period, it was observed that a considerable amount of moisture had accumulated of the pipe specimens insulated with mineral wool and PUR pipe specimens. This was not seen on the FEF insulated pipe (Figure 2). This indicates that the vapour barrier on the mineral wool and PUR insulation materials have both failed in the experiment.

Figure 2. Photos of pipe surface after insulation material have been removed.



To investigate the potential long-term effects of moisture absorption, the Fraunhofer Institute simulated how the insulation materials could behave over a period of ten years. Several assumptions were made for this calculation: The pipe would run at a line temperature of 5°C in an ambient environment of 35°C and relative humidity of 80%. Their results indicate that the moisture content in FEF would still be under 5%, while that of mineral wool and PUR would rise to almost 20% and 25% respectively after ten years (Figure 3). Also, the λ-value of FEF would rise by only 15%, while that of mineral wool and PUR would have increased by 77% and 150% respectively (Figure 4).

Figure 3. Simulation of percentage increase in moisture.

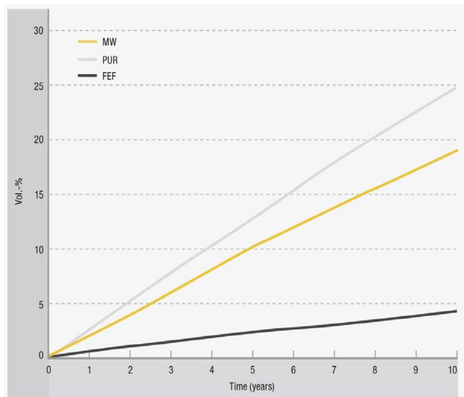
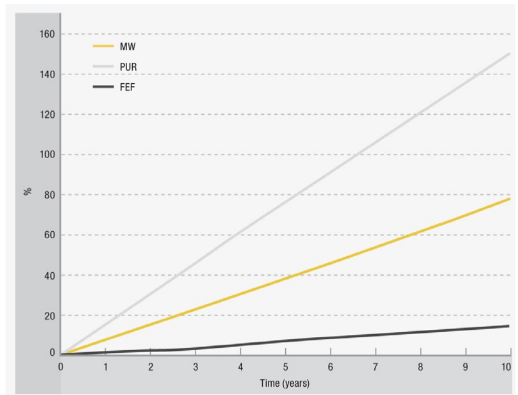


Figure 4. Simulation of percentage increase in thermal conductivity



Conclusion

This test demonstrated that closed-cell flexible elastomeric foams, such as ArmaFlex which have an integrated vapour barrier, are more tolerant against small defects in the insulation as compared to other tested insulation materials, whose condensation control performance is largely dependent on an additional vapour barrier. Hence, when selecting the right insulation material for long-term reliable performance, flexible elastomeric foams are recommended.

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As the inventors of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal, acoustic and mechanical solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With 3,100 employees and 24 production plants in 16 countries, the company operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for high-tech and lightweight applications and next generation aerogel blanket technology.

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