Sub : Summary of Research & Evaluation done
At CRREL for several insulation materials
FOR ROOF APPLICATION
(over 1000 days test)
(Approved by U.S.Army corps of Engineers)

Generally the selection of thermal insulations for the roof applications are being done considering the properties such as Its thermal resistance values, compressive strength and its water absorption based upon laboratory test results. It has been established since two decades ago that such results are often misleading. The fact that moisture gain picked up by insulation affect their insulating ability is often not visualized and considered.
It was also established that foam plastics insulation gain much more moisture when subjected to thermally induced vapor pressure gradient than when soaked under isothermal conditions because there is always a significant temperature gradient through roofs. Isothermal soaking is not a realistic test condition for predicting the installed performance of insulations in roofs.
Exhaustive tests were done for many years at CRREL (cold regions research and engineering laboratory, Hanover) to determine moisture gain and its thermal consequences for common roof insulations when subjected to thermally induced vapor pressure gradients such as are present in roofs.

The insulation wetting test program was put in place and common thermal roof insulation such as extruded polystyrene, expanded molded polystyrene, foam glass, polyurethane etc were prime subject for study and evaluation. The tests revealed that essentially all insulations can get wet when they are subjected to thermally induced vapor pressure gradients such as are present in roofs. Tests continued for several years on materials that wet very slowly such as extruded polystyrene and cellular glass.

Conclusion

Moisture reduces the insulating ability of insulations. The rate of wetting varies greatly among insulation types and performance curves were developed. The reduced thermal value is termed thermal resistance ratio (TRR).

TRR- it is the ratio of material's wet thermal resistivity to its dry thermal resistivity, expressed as a percentage, a dry specimen has a TRR of 100 percentage. As moisture accumulates in insulation its TRR decreases.

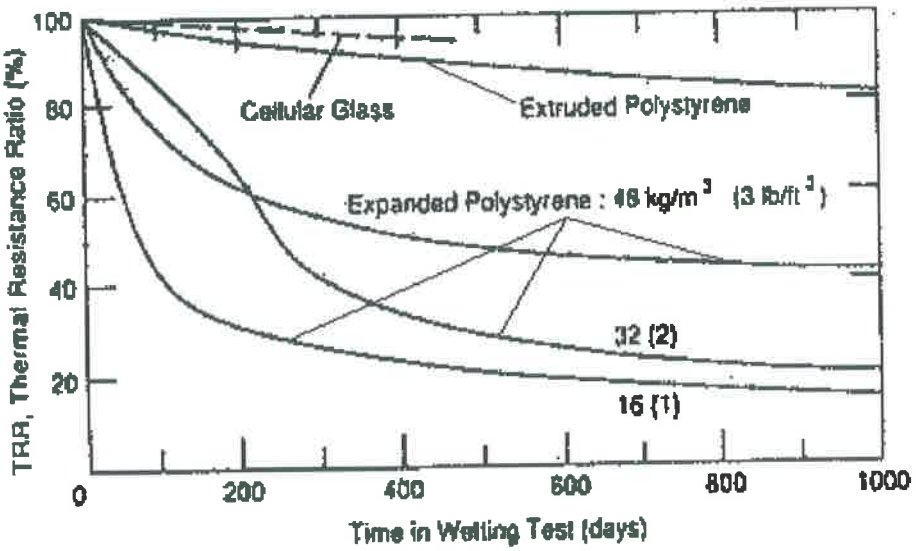
Third International Symposium of roofing technology was held in April 1991 in Canada. Its proceedings were published to help the worldwide roofing community. The U.S Army corps of engineers approved its findings and National Roofing contractors association gave their permission for its publication. The new wetting curves for common roof insulating were made available to build a strong worldwide roofing community. TRR remained an acceptable criterion on selection of insulating material.

PASS-FAIL Moisture Content

It was recommended to use a TRR of 80% as the lowest acceptance value for any roof insulation.
Insulation with a TRR below 80% is considered" wet" and unacceptable due to its loss of insulating ability. (A dry insulation has a TRR of 100%. As moisture accumulates in a an insulation its TRR decreases)

Performance Curve

Ref:- Third International Symposium on Roofing technology



Decay of TRR with time under test for specimens of cellular glass, extruded polystyrene and expanded polystyrene.

The above curve shows that TRR of extruded polystyrene of density 32 kg/m^3 stays above 80 percent even after 1000 days of continuous tests,

where as TRR of expanded molded polystyrene of density 48 kg/m^3 drops at 42% and TRR of expanded molded polystyrene of density 32 kg/m^3 drops to 20%, when subjected to the same test conditions and test period of 1000 days.

Conclusion

TRR decay with time was obvious . Only the extruded polystyrene and the cellular glass could survive for years without gaining much moisture and qualify to be used on the roofs. It is imperative to note the cellular glass can be destroyed by freeze- thaw action when moisture is present.