Plasti-Fab EPS PRODUCT SOLUTIONS
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Product Information Bulletin

In Situ Performance of EPS Insulation Below-Grade

In 1995, the Expanded Polystyrene Association of Canada (EPAC) established a joint research project with the National Research Council (NRC) of Canada/Institute for Research in Construction to assess the in situ performance of expanded polystyrene (EPS) insulation used as exterior basement insulation in contact with the ground.

In October 1995, ten (10) EPS insulation specimens meeting CAN/ULC-S701, Types 1 and 2 were installed on the exterior basement wall of Test Hut #1 on the NRC Montreal Road Campus located in Ottawa, Ontario. These specimens were instrumented prior to backfilling and their in situ thermal performance was monitored over two full years. Soil temperatures and moisture content were monitored concurrently. Weather events were recorded on a daily basis.

Analysis of the surface temperatures of the specimens detected the presence of water at the outer surface of the insulation through various periods of heavy rain and major thaws. Over the same period, there was no evidence of significant water penetration through the EPS insulation layer to the surface of the concrete basement wall on the inside face of the insulation.

The thermal performance of the EPS insulation specimens was found to remain stable over two years of monitoring. Temperature profiles at the specimen/soil interface, and corresponding observations of heavy rainfall or thaw periods, indicated that specimens 'handled' moving water at the specimen surface in contact with the soil confirming performance as a capillary-breaking layer. As well, water movement at the exterior face did not significantly affect the thermal performance of the EPS insulation.

There was also independent evidence – no temperature deviations on the inside face of the insulation and clean interior surface observed on removal of the insulation – that confirmed the EPS insulation protected the concrete structure during these events. Since there was no evidence of water movement behind the EPS insulation board, the performance of insulating board with grooves in the surface against the basement wall and vertical shiplap joints between adjacent insulation boards was indistinguishable from insulation boards without grooves or vertical shiplap joints.

Insulation specimens were retrieved after 30 months of exposure in the soil and laboratory testing was performed to determine thermal resistance, moisture content and mechanical properties. Material properties for retrieved specimens were compared with control specimens tested at the start of the project as well as specimens stored in laboratory conditions for the duration of the field exposure.

The following in situ soil exposure conditions had no effect on the observed performance of EPS insulation specimens used on the exterior of basement walls for this project:

- duration of exposure
- mean temperature of the specimen
- water movement at the outer surface
- density of product
- freezing cycles

The following observations were made regarding EPS insulation material properties measured after being subjected to a 30-month field exposure:

LOW WATER ABSORPTION – After field exposure to high moisture content soil conditions, the moisture content of all EPS insulation board types was found to be less than 0.5% by volume.

NO LOSS OF R-VALUE – Thermal performance of the EPS insulation monitored in situ was found to remain constant. Laboratory tests conducted on samples retrieved after 30 months of exposure in the high moisture content soil confirmed no change in thermal performance when compared to pre-exposure properties.

NO CHANGE IN MATERIAL PROPERTIES – Control samples were tested at the start of the project, as well after exposure to laboratory conditions for the duration of the project. Test results for samples retrieved after 30 months of exposure in the high moisture content soil exhibited no measurable change in performance when compared to the control specimens tested at the start of the project and laboratory-exposed specimens.

NO ADVERSE EFFECTS FROM FREEZE-THAW CYCLING – The research project included development of a draft ASTM test protocol to provide a means of assessing performance of all types of insulation subjected to extreme thermal gradient and environmental cycling. NRC subjected EPS insulation to freeze-thaw cycling simulating exposure to extreme field conditions over an extended period and observed no effect on the thermal and mechanical performance of the EPS insulation tested (See Plasti-Fab PIB 201 for additional information).

In summary, the results of the EPAC/NRC research project confirmed that either Type 1 EPS insulation (***PlastiSpan***® insulation) or Type 2 EPS insulation (***PlastiSpan HD*** insulation) are cost effective insulation materials for all types of below-grade applications including the exterior of foundations, shallow foundations and floor slabs in both residential and commercial construction.