RIMA International
Reflective Insulation Manufacturers Association International

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"REFLECTIVE INSULATION MATERIALS USED UNDER CONCRETE SLABS"

In both the United States and Canada there is significant interest in the use of reflective insulation materials in concrete floor systems. These materials typically have one or more aluminum foil surfaces and consist of flexible foam cores or cores with one or more layers of air filled bubbles (bubblepack). The most common concrete floor system consists of a sub-soil layer, 4 to 6 inches of gravel, a reflective insulation material, and a 3 to 4 inch thick concrete slab that often incorporates radiant heating tubes. Since these floor systems do not typically incorporate air spaces adjacent to the aluminum foil surface(s) of the reflective insulation material, the Reflective Insulation Manufacturers Association International (RIMA-I) believes that it is important to clarify the expected performance of reflective insulation materials used in this manner. It is important to understand that the thermal efficiency of a concrete floor system can be enhanced by incorporating an insulation, whether reflective or non-reflective and that, in addition to improving thermal efficiency, an insulation can offer other important benefits such as durability, low water vapor transmission, moisture resistance, radon resistance, termite resistance, and ease of installation.

Enhanced Thermal Efficiency

As with any application involving the use of insulation, it is important to understand the contribution of the insulation to the overall thermal performance of the system. In order to demonstrate thermal performance, a section of the system can be evaluated using ASTM, ANSI, or other consensus test methodologies designed for evaluating that type of system. In the event that applicable standards do not exist, examples can be used to calculate energy efficiency or heat loss reduction by taking into account factors such as the actual thermal resistance values of the various concrete floor system components, the mode of heat transfer, and HVAC load requirements.

In order to more fully understand the influence of reflective insulation materials in concrete floor systems, RIMA-I obtained the services of a consulting firm specializing in thermal performance (R & D Services, Inc.). Thermal efficiency calculations were used to generate an estimate for a typical case involving reduction in heat loss for a common concrete floor system. The calculation is based on steady-state thermal conditions with an isothermal plane at the heating pipes and a plane between the gravel and the ground. The ground temperature was 55 degrees Fahrenheit, while the temperature of the heating pipes was 125 degrees Fahrenheit. The calculation assumes two inches of concrete (R-0.10) below the heating pipes, and five inches of gravel (R-0.75). A reflective insulation material (R-1.10) is located between the concrete and the gravel (the total thickness of the concrete floor system is roughly nine inches). The system R-value of R-1.95 results in an energy savings or reduction in heat loss of 56% when compared to the same concrete floor system without insulation. It is important to note that the calculation used to generate the example described above does not include any additional thermal benefit resulting from the aluminum surface(s) of the reflective insulation material. In other words, the reflective insulation material is performing similar to a non-reflective insulation material [ASTM C 168, ASTM C 727, and ASTM C 1224 define a reflective insulation as a thermal insulation consisting of one or more surfaces having an emittance of 0.1 or less, which equates to a reflectance of 0.9 (90%)].

Response to Compressive Loads

When reflective insulation materials are used below concrete slabs, it is important that they withstand the weight of the slab without damage to the insulation. Compressive strength testing of various reflective insulation products indicates that they exhibit less than 10% compression in thickness when subjected to loads associated with the concrete floor system described above (Note: The amount of pressure under a typical four inch concrete slab section is less than one pound per square inch).

Moisture Vapor Transmission Properties

Reflective insulation materials exhibit very low moisture vapor transmission rates, resulting in perm values near zero when tested in accordance with ASTM E 96 (Test Methods for Water Vapor Transmission of Materials, Desiccant Method). When these materials are used in concrete floor systems, they perform as a water vapor retarder when the seams are overlapped to form a continuous sheet.

Moisture Absorption

Reflective insulation materials typically consist of core materials such as flexible foam or a layer(s) of encapsulated air bubbles that incorporate one or more aluminum foil sheets within the structure. For this reason, liquid moisture is not absorbed and does not pass through these materials, thus making them ideal for use under concrete slabs.

Radon Resistance

In new construction applications, building codes require that a continuous membrane of six mil polyethylene or equivalent flexible sheeting material be used to retard the flow of soil gases into a home or building. For example, the 2000 International Residential Code describes the use of a soil-gas retarder in Section AF103.3. This Section indicates that the soil-gas retarder shall be placed over the soil prior to casting the slab and must cover the entire floor area. Reflective insulation materials are ideal for use as soil-gas retarders because they typically consist of polyethylene structures and are durable enough to withstand the rigors of concrete slab applications.

Termite Resistance

In areas where termite infestation is only slight to moderate, the durable aluminum sheets within the reflective insulation structure will act as a mechanical barrier to termites. When reflective insulation materials are used in areas that are considered to have “very heavy” infestation, local building codes should be referred to for guidance [see Figure R301.2(6) of the 2000 International Residential Code, Termite Infestation Probability Map].

Durability and Ease of Installation

Reflective insulation materials can withstand the rigors of foot traffic, which is a common occurrence in concrete slab applications. In addition, they are strong enough to withstand typical job site handling without tearing. These materials are available in rolls of various sizes to meet the needs of various construction applications. They can be easily handled and unrolled and do not require any special tools or equipment for installation, thus resulting in reduced installation time and labor. As with all products, the manufacturer should be contacted for product specifications and installation guidelines.

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