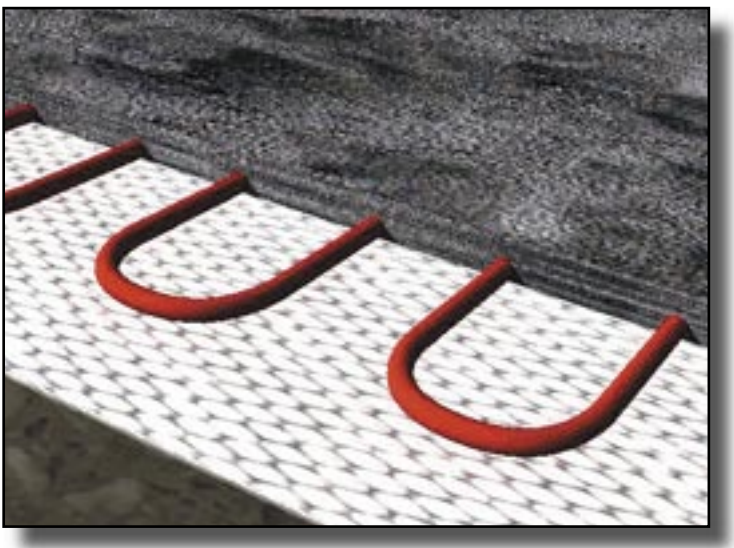
Foiled Again

Understanding Reflective Insulation Under Slabs

by Lawrence Drake
RPA Executive Director

Extreme cold weather in the western and north central parts of the country have, once again, put the insulation of slab-on-grade radiant heating systems to the test. Reports have been coming in of poor performance and high energy bills on systems installed using reflective insulation under the slab.



The promise of high R-values and more efficient heat transfer from a product that is only a quarter of an inch thick, easy to handle, flexible, and rolls out over irregular ground on the jobsite is very attractive. Too many contractors turn a deaf ear to the concerns about the actual insulation properties of foil in under-slab applications in favor of the ease of installation.

Before going any further, it should be recognized that foil does have its place. It can be very effective in restricting heat flow. It does this in two ways. One, it reflects long wave radiation. Two, it has low emissivity and therefore does not reject heat very well. This, of course, assumes that the metal, usually aluminum, is fully aluminum and not just a painted surface, and that it is highly polished.

Polished aluminum, like a mirror, is a reflector. Just like a mirror, if it gets covered with dust or the surface gets dull, its reflective properties are diminished. A reflective insulation must also have an airspace to function. If you press your hand up against a mirror, you won't get any reflection. If you push a warm surface up against a reflective insulation, you won't get any heat reflection either. In fact, the reflector then becomes a conductor of heat. On the other hand, properly placed in a joist space under a heated floor, reflective foil will perform as designed.

The reflective surface becomes a conductor when in contact with concrete

On the back side, the side that is facing away from the heat source, polished aluminum is very poor at rejecting heat. This is a good thing when you don't want excess heat traveling down into the space below.

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You don't see many polished radiators, other than some decorative towel warmers. Polished radiators don't emit heat very well.

Neither the reflection nor the rejection attributes that make a reflective insulation effective in a joist bay are present in an under-the-slab application. Concrete comes in direct contact with the top surface of the reflective barrier, and the ground comes in direct contact with the bottom surface, making both surfaces conductors.

Some reflective insulation products use an encapsulated bubble or a thin layer of poly foam between the aluminum foil. While this does create a small air space, the material of the bubble or the foam comes in direct contact with the foil, rendering any airspace minimally affective as far as reflectivity is concerned. The primary insulation value derived from this sandwich of material when embedded beneath a concrete slab, is the air entrapped by the bubble or the foam. RIMA tests put a bubble foil R-value at about R-1.10.

Under-slab heat losses

In most cases where the ground is dry, the water table is deep, and there is no rock ledge or other solid formation to carry away heat, heat loss to the ground is minimal. Under-slab insulation may not be required or cost effective in many applications. On the other hand, perimeter insulation is a must. The closer the heated slab is to the outside and the shorter the distance through the ground heat has to travel to cold, the more insulation is required. This explains the cold weather complaints. If no perimeter insulation is applied, other than the reflective product, as the outside temperature drops, the spread between the warm perimeter slab and the outdoors drives the heat through the ground, through the footings, taking the shortest path to the cold. Downward loss under the slab in the center remains fairly constant.

Bottom line

Reflective foil under a slab, with no airspace, is totally ineffective as an insulator. Reflective foil with a bubble or foam core is only slightly more effective than the bubble or foam by itself. Be sure you understand the insulation qualities of the material you are working with. A bubble foil or bubble foam product can create a thermal break under a slab, but should not be substituted for effective slab edge insulation unless used in multiple layers to get an appropriate thickness.

Follow the insulation recommendations in the RPA Guidelines. Insulate the perimeter to below the frost line to at least the minimum in the following formula.

[Inside Temperature - Outdoor Temperature X 0.125 = R-value]

Insulate below the slab if there is ground water or thermally-conductive subsoil to minimum of R-5. Use materials that have independent laboratory confirmation of R-values.

For more information on reflective insulation under slabs, visit the Reflective Insulation Manufacturer Association at www.rima.net.