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The Oxidation of Metallized Aluminum Films Used in Reflective Insulation and Radiant Barrier Applications

A metallized aluminum surface, when first exposed to a relatively dry oxygen-containing environment, will form a clear oxide layer that is tightly bound to that surface. This oxide layer, also identified as AL_2O_3, will increase in thickness over a period of time until, eventually, growth will cease as a result of the barrier properties of the oxide layer.

The phenomenon described above applies to almost all aluminum surfaces, and is indeed consistent for thin vacuum deposited layers and bulk aluminum foil. The difference, however, is in the amount of sacrificial aluminum available to be consumed by the reaction. In the case of an aluminum foil, for example, thicknesses for radiant barrier and reflective insulation applications generally range from 6 to 10 microns; even in the most aggressive of environments, heavy oxidation of the foil surface will have little, if any, impact on the emissive and reflective properties of the surface. This is generally due to the fact that the oxide layer will rarely grow to a thickness that either absorbs large amounts of thermal radiation, or consumes the aluminum entirely, resulting in an optically clear 100% aluminum oxide film.

Metallized aluminum, however, is made up of a very thin layer of aluminum deposited onto a polymer film. Compared to aluminum foil, the vacuum deposited aluminum layer can be more than 300 times thinner (.03 microns compared to 6-10 microns). This means that very little oxidation of the aluminum layer need occur to have a considerable impact on product performance. This is especially critical for radiant barrier and reflective insulation applications that rely heavily on the low emissive properties of aluminum.

Unlike bulk aluminum foils, metallized aluminum films, for reasons discussed in this bulletin, require a protective layer to prevent oxidation and moisture from adversely affecting the aluminum layer. It is critical that this coating be thick enough to provide sufficient protection, yet be thin enough so as not to increase the intrinsic emissivity of the aluminum layer. These specialized coatings are commercially available today and must be used on metalized aluminum films that are intended for reflective insulation and radiant barrier applications. Additionally, adhesion, durability, and chemical resistance of the protective layer must be such that it is able to withstand handling encountered during installation. Methods such as roll coating and vacuum polymer coating are typically employed to deposit this protective layer.

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