CUSTOMER BULLETIN 05-10

POLYISOCYANURATE VS. POLYURETHANE INSULATION

PURPOSE

This Customer Bulletin is one in a series of white papers aimed at providing our clients, engineers, contractors, fabricators, and friends with objective information on our products and those of our competitors. A surprisingly large number of potential buyers of polyurethane (PUR) insulation are unaware of the advantages or even the existence of polyisocyanurate (PIR). Some may even think they're the same thing. The fact is that the differences are considerable.

This Bulletin should help end-users better understand their alternatives. Note that while this Bulletin is focused on generic differences between PUR and PIR foams, there are indeed differences between the physical properties and performance characteristics of competing PIR insulations. We recommend end-users view other Customer Bulletins from Dyplast that address these differences.

POLYURETHANE BACKGROUND

Rigid foam insulation under the general category "polyurethane" can be made with quite different formulations and therefore quite different physical properties and performance characteristics. The chemistry of ISO-C1 and ISO-HT polyisocyanurate (polyiso or PIR) is based on a modification of the traditional polyurethane formulations. Two major raw materials are used in the production of polyiso insulation: polyisocyanates and polyols. The chemistry of polyiso is based on a key parameter known as "index". Index is defined as the ratio of polyisocyanates to polyols. At a 1:1 ratio, or 100 index, the resultant products are classified as pure urethanes. In fact, the closer the index is to 100, the more urethane-like the foams behave. Very high index foams utilize a large excess of polyisocyanate, which yields a large amount of the cyclical "trimerized" polyisocyanurate structure. This structure results from the reaction of three isocyanate groups. Hence, as more polyisocyanate is used, more of these ring structures are formed, resulting in a higher index foam. The nature of this ring structure imparts many advantageous properties to the insulation including dimensional stability, thermal stability, solvent resistance, and superior flame resistance. Polyiso foams are formulated to have a high index and therefore a high concentration of these advantageous polyisocyanurate rings. Distinguishing between a polyurethane and polyiso is a useful way to judge the properties of these two very different materials.

ISO-C1 (Class 1 insulation for temperatures between -297 and +300F) and ISO-HT (for temperatures up to 400F) brands include a complete line of rigid modified polyisocyanurate foam bunstock available in a range of densities between 2.0 to 10.0 lb/ft^3. These products can be fabricated into various thicknesses and shapes to satisfy a variety of specialized or general insulation construction needs, including mechanical insulation as well as sheets.

POLYISO VS. POLYURETHANE PROPERTIES

SERVICE TEMPERATURE

While incorporating the isocyanurate structure into polyiso does not affect thermal conductivity, it plays a major role in improving most other key properties. One such property is the service temperature. The cyclical ring structure that is unique to polyiso makes it very stable at high temperatures when compared to urethanes. At temperatures above the stable regime (>300°F), the isocyanurate structure causes polyiso to have a tendency to char instead of burn.

FLAME RESISTANCE

Another important improvement which is seen with polyiso when compared to a urethane is in the flame resistance. Over the years, urethane-type foams have been reputed to "burn like paper". But the high index nature of polyiso foams resists this burning. In fact, polyiso foams pass many of the mandatory burn tests without the addition of external flame retardants.

RESISTANCE TO WATER AND SOLVENTS

Since ISO-C1 two-pound density insulation is >95% closed cell, it has a low permeance to water (2.33 perm-in) and very low water absorption characteristics (0.24% by volume). This absorption is minimized by the chemical structure of our polyiso formulation. The cross-linked cyclical ring structure also helps it to resist chemicals and solvents. Incidental contact between solvents and polyiso will cause little or no damage to the foam.

DIMENSIONAL STABILITY

Perhaps the biggest improvement polyiso offers over urethanes is the dimensional stability. Because of its highly cross-linked structure, polyiso is very stable at varying climatic conditions. This structure is rigid enough to resist movement by the fabricated foam, making the "growth" and "warp" which has been associated with urethane type foams very negligible with polyiso. This factor also proves advantageous during the handling and installation of polyiso.

SUMMARY

These factors, along with the ease of fabrication of polyiso, (another advantage imparted by the high index) differentiate it from historical urethane foams. Hopefully, in the future, polyiso brand foams will not be mistaken with the urethanes and will be recognized as a distinct and different insulation.