TECHNICAL BULLETIN 0418 (an update of TB 0214)
POLYISO vs. XPS PIPE INSULATION SYSTEMS

PURPOSE

Dyplast's 0214 Technical Bulletin was focused primarily on examining the cost of insulation systems versus energy savings and long-term performance of polyisocyanurate (polyiso or PIR) and extruded polystyrene (XPS) insulants in low-temperature applications such as refrigeration and chilled water applications. It's no surprise that polyisocyanurate was the hands-down selection based purely on physical properties, cost, and demonstrated thermal efficiencies in practice.

Today, while the facts remain mostly the same, this Bulletin revision is more-so focused on the misinformation and/or lack of full disclosure so prevalent in the marketplace. Dyplast has aggressively advocated over the past decade for:

- honest presentation of physical properties and pertinent information, yet also
- full-disclosure, complemented with
- third-party verification and audit of physical properties and the quality process.

We have polled a large number of both specifier-engineers and insulation end-users regarding some of the *basics* regarding selection of the optimal insulant. A surprisingly large number were frustrated by the misinformation in the marketplace and the difficulties in slicing through the fog. You may wish to consider just a couple of our questions from our survey, which was administered after the individuals were given the latest datasheets downloaded from the websites of various polyiso and XPS manufacturers[1]. How would you answer?

1) Does XPS "age"?
    a. If so, do alternative suppliers present *aged* thermal conductivities?
    b. Comment: different blowing agents used by XPS suppliers may result in different aging characteristics.
2) Does ASTM C578 (governing XPS) require physical properties measured at multiple locations in the billet/bun as does ASTM C591 for polyiso?
3) Does thermal conductivity improve at lower temperatures for both XPS and polyiso?
    a. If so, do physical property tables for alternative insulants specify the temperatures at which k-factors were measured, and are the temperatures indicative of actual field conditions?
4) If the working fluid (e.g. ammonia refrigerant) temperature is -40°F (-40°C) and the ambient temperature is 75°F (24°C), should the insulant be selected based on its properties at -40°F, the "mean" between -40°F and 75°F, or *other*?
    a. Tricky question, but #1) the answer is clearly neither -40°F nor +75°F, and #2) it's likely more around +20 to +25°F, and #3) it's actually more complex than simply estimating a *mean* temperature; engineer/specifiers should reference calculators such as 3E-Plus®[2] that essentially perform an integration across the pipe insulation that has a smaller

[1] There are several manufacturers of XPS for pipe insulation, and several "Types", each with different compressive strengths and other properties. XPS pipe insulants also likely have different physical properties than the typical sheet/board products used in residential and commercial building construction.
[2] A registered trademark of the North American Insulation Manufacturers Association.

surface area and a larger outer surface area (also covered with vapor barrier and jacket, and subject to wind, moisture, and solar radiation, among other things).

5) Is Water Absorption or Water Vapor Transmission[3] a pertinent consideration for an insulant with a pipe temperature of -40°F?

   a. Another trick question? Obviously, ***if*** water or moisture would penetrate the insulant near a refrigerant pipe (and it should not), it would be ice at that point. [Note: some XPS suppliers falsely imply there is residual moisture inherent within polyiso insulation; the fact is there is no residual water or moisture within a fabricated pipe segment.]

   b. In order to have moisture or water penetrate a properly designed insulation system, the vapor barrier must be breached via improper installation or mechanical abuse. And in such cases, the insulant's resistance to water/moisture then becomes the "*backup plan*".

   c. The WA and WVT of polyiso and XPS are comparable and each has relatively excellent values compared to alternative insulants.

6) What are the advantages of a Vapor Barrier Wrap versus a Vapor Retarder Wrap to enclose the PIR or XPS insulation system?

   a. A vapor barrier has a permeance of less than 0.1 perm, and there are several brands with *zero* permeance. A vapor "retarder" has a permeance greater than 0.1 perm but less than or equal to 1 perm.

   b. Given the WA/WVT discussion above, the use of a vapor *retarder* (as recommended by some XPS manufacturers) appear to be less than optimal in most low-temperature applications, yet it may be considered acceptable in certain applications such as chilled water in lower humidity environs.

[3] Measured and expressed as either Permeability (perm-inches) or Permeance (perms). For insulants greater than 0.5 inches thick, permeability is the correct property to consider.