QWIK GUIDE: POLYISOCYANURATE vs EXTRUDED POLYSTYRENE IN MECHANICAL INSULATION APPLICATIONS

BACKGROUND

Polyisocyanurate (polyiso or PIR) and Extruded Polystyrene (XPS) are each used in mechanical insulation applications at "lower" temperatures - - generally below low-temperature steam and ideal for below-ambient. Per industry norms, the lower the temperature (through cryogenic), the less often XPS is used; and the more often polyiso is used. And where cycling temperatures may exceed 165°F (74°C), XPS cannot be used since it softens; whereas polyiso is suitable at 300°F (149°C) and beyond per some manufacturers (e.g. Dyplast). Physical properties of PIR and XPS are quite different, and indeed the properties vary among manufacturers of the *same* class of insulant. Clients should insist on full disclosure of properties.

Some facts:

- Polyiso is a *thermoset* that does not melt even at temperatures above 300°F (149°C), while XPS is a *thermoplastic* that increasingly softens above 165°F (74°C)
- Different XPS manufacturers state very different physical properties, such as k-factor, without explanation yet XPS *sheet* manufacture is quite different from *billet* production, so that may be the basis
- At least one XPS manufacturer does not disclose the Global Warming Potential (GWP) of the chemicals inherent in the product, raising questions about performance, as well as full disclosure, and compliance with international protocols
- One XPS manufacturer produces "pipe billets" up to 10 inches by 20 inches; whereas Dyplast polyiso offers up to 48 by 24 inches (*clean*, after cutting) and virtually any length, making fabrication exceedingly more cost-effective
- Another name-brand XPS manufacturer produces sheets that must be glued together to achieve a size suitable for fabrication of pipe/equipment insulation segments
- XPS manufacturers report relatively low Flame/Smoke results per ASTM E84 testing; many authorities urge caution in evaluating such results since XPS melts off the support grid and continues to smoke on the floor of the *tunnel*
- Polyiso generally costs less than XPS billets.

THERMAL CONDUCTIVITY

Insulation over pipe and equipment has a primary purpose - - *to insulate* over the short and long term! Thus, aged thermal conductivity (k-factor) should be low. The k-factor of Dyplast's ISO-C1 is lower than XPS, and improves rapidly as the application temperature decreases. The table below indicates the k-factors advertised by two leading XPS billet providers, measured at 75°F per ASTM C518, compared to a polyiso. Note that the Foamular pipe billets are Type IV per ASTM C578 (a minimum density of 1.45 and minimum compressive strength of 25 psi). The other XPS product is Type XIII, with a minimum density of 1.6 with minimum compressive strength of 20 psi.

MANUFACTURER	PRODUCT	DENSITY	COMPRESSIVE STRENGTH	K-FACTOR	SERVICE TEMP.
Owens Corning®	Foamular® pipe billets	1.55 pcf	≥ 25 psi	0.20	-320 to 165F
Dow®	XPS PIB	1.6 pcf	20 psi	0.259	-196 to 165F
Dyplast®	ISO-C1®/2.0	2.04 pcf	25 psi	0.19	-297 to 300F