QWIK GUIDE: Polyiso vs. Elastomeric: Refrigeration and Process Pipe Applications

QUICK PERSPECTIVES

- This Qwik Guide focuses on industrial refrigeration applications and process applications (such as food, beverage, and pharma from -100°F to +350°, yet conclusions can generally be extrapolated well beyond this range.
- While the majority of refrigeration and process facilities are made with carbon steel piping, there instances where stainless steel is used - - and infrequently, austenitic stainless steel.
- Polyisocyanurate (polyiso or PIR) insulants have many decades of demonstrably successful performance in refrigeration and process applications (and in other segments from -297°F to +350°F) and across the breadth of metallurgies and processes.
- Elastomeric insulants vary in their chemistries, and thus physical properties (e.g. NBR/PVC, EPDM, etc.); products may be sheets or tubes - - each with different characteristics.
- Since elastomeric insulation has 30 to 47% poorer thermal conductivity when compared to polyiso (per ASTM C177 and C518), and when elastomeric insulation is more expensive, the essential question is "why use it?"
- Some elastomeric insulant suppliers advertise that their product is "superior" in Austenitic Stainless Steel applications since it *may have* lower Leachable Chloride content than polyiso, and thus is acclaimed less susceptible to Stress Corrosion Cracking (SCC)[1], YET the facts are:
    - It is generally accepted that SCC occurs only at temperatures from 140°F to 250°F, and requires moisture (that can be avoided with a proper *insulation system*), a threshold of certain ions such as chloride, and time
    - Polyiso chloride content in comparable to elastomerics, and sometimes less
    - Note: neither non-austenitic stainless steel nor carbon steel nor copper exhibit SCC!
- At least two elastomeric insulant manufacturers offer tables[2] of pipe sizes versus R-value (i.e. thermal resistance) given a particular insulant thickness that do not reflect product performance, but rather geometry:
    - These elastomeric R-value tables are somewhat illusory (see next sentence) when they indicate R-values up to "20" for a two-inch thick insulant
    - These R-values are the result of calculating R-values based on a cylindrical geometry (a novel approach) rather than flat - - which is the ASTM standard convention for measuring thermal heat flux!
    - This is not necessarily a deceptive practice, yet using the same calculations, polyiso always has superior thermal performance! (see page to for comparative tables)

SUMMARY

To echo the points made in Technical Bulletin 0520 and 0620, the demonstrable conclusion is that polyisocyanurate (ISO-C1®) has better thermal insulation properties than any elastomeric on the market - - and at a lower installed cost!

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[1] Chloride stress corrosion is a type of intergranular corrosion and occurs in austenitic stainless steel under tensile stress in the presence of oxygen, chloride ions, and 'high' temperature.

[2] http://www.armacell.us/fileadmin/user_upload/Reference_Sheets_INS/AP_ArmaFlex_Tolerances_and_R_Values.EN.US.2017.pdf; and http://www.kflexusa.com/downloads/Technical%20Data%20Sheets%20-%20Insulation/K-Flex%20Insul-Tube.pdf

Nominal R-Value Tables Adjusted to Cylindrical Geometry[3]

1" Thick Insulation Walls

Pipe	Pipe ID (inches)	R-value ISO-C1®	R-value Elastomeric
copper	1	9.3	7.2
copper	1.25	9.3	7.2
copper	1.5	9.3	7.2
IPS	1.5	9.0	6.9
copper	2	8.7	6.8
IPS	2	8.4	7.1
copper	2.5	8.3	6.5
IPS	2.5	8.1	6.8
copper	3	8.1	6.3
IPS	3	7.9	6.6
copper	3.5	7.9	6.2
copper	4	7.7	6.1
IPS	4	7.6	6.4
IPS	5	7.3	6.2
IPS	6	7.2	6.1
IPS	8	7.0	5.9
IPS	10	6.9	5.8

2" Thick Insulation Walls

Pipe	Pipe ID (inches)	R-value ISO-C1	R-value Elastomeric
copper	1	19.8	14.5
copper	1.25	18.8	13.7
copper	1.5	17.9	13.1
IPS	1.5	17.3	12.4
copper	2	16.7	12.2
IPS	2	16.1	12.3
copper	2.5	15.9	11.6
IPS	2.5	15.4	11.7
copper	3	15.2	11.1
IPS	3	14.8	11.2
copper	3.5	14.8	10.7
copper	4	14.3	10.5
IPS	4	14.0	10.7
IPS	5	13.5	10.2
IPS	6	13.1	9.9
IPS	8	12.6	9.5
IPS	10	12.2	9.2

Notes:

1. R-values units are ft2·°F·h/BTU
2. R-values for ISO-C1 are calculated using Armacell's formula on their website: R = [r2 * (ln (r2/r1)] / k, where r2 is outer OD of insulant, r1 is ID, and "ln" is the natural log
3. Elastomeric R-values generally reflect those advertised by elastomeric suppliers
4. K-Flex lists comparable R-values in their Insul-Tube datasheet
5. R-values can vary based on pipe/tube OD, insulant ID, tolerances in fabrication of insulant thickness, etc.

[3] Dyplast does not intend that these R-values be used in any calculations involving thickness or performance requirements. Dyplast does not necessarily endorse this particular equation for *R-value calculations adjusted for cylinders*, yet uses them to offer an apples-to-apples comparison with certain elastomeric suppliers.